US008863541B2

(12) **United States Patent**
Swofford et al.

(10) **Patent No.: US 8,863,541 B2**
(45) **Date of Patent: Oct. 21, 2014**

(54) **AIR DISTRIBUTION SYSTEM FOR TEMPERATURE-CONTROLLED CASE**

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(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 1396 days.

(21) Appl. No.: **12/506,984**

(22) Filed: **Jul. 21, 2009**

(65) **Prior Publication Data**

US 2010/0313588 A1 Dec. 16, 2010

Related U.S. Application Data

(60) Provisional application No. 61/185,890, filed on Jun. 10, 2009.

(51) **Int. Cl.**
A47F 3/04 (2006.01)

(52) **U.S. Cl.**
CPC *A47F 3/0443* (2013.01)
USPC **62/255**; 62/256

(58) **Field of Classification Search**
CPC A47F 3/0447; A47F 3/0443; F25D 23/023
USPC 62/255, 256
See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

3,119,241 A 1/1964 Wile
3,125,864 A * 3/1964 Ural 62/256
3,256,799 A 6/1966 Beckwith et al.
3,270,655 A 9/1966 Guirl et al.
3,771,323 A 11/1973 Simons et al.
3,937,033 A 2/1976 Beckwith et al.
4,124,996 A 11/1978 Kennedy et al.
4,269,037 A 5/1981 Karashima

(Continued)

FOREIGN PATENT DOCUMENTS

WO WO-2005/058101 A1 6/2005
WO WO-2006/115824 A2 11/2006
WO WO-2008/051226 A1 5/2008

OTHER PUBLICATIONS

U.S. Appl. No. 12/480,510, filed Jun. 8, 2009, Barreto et al.

(Continued)

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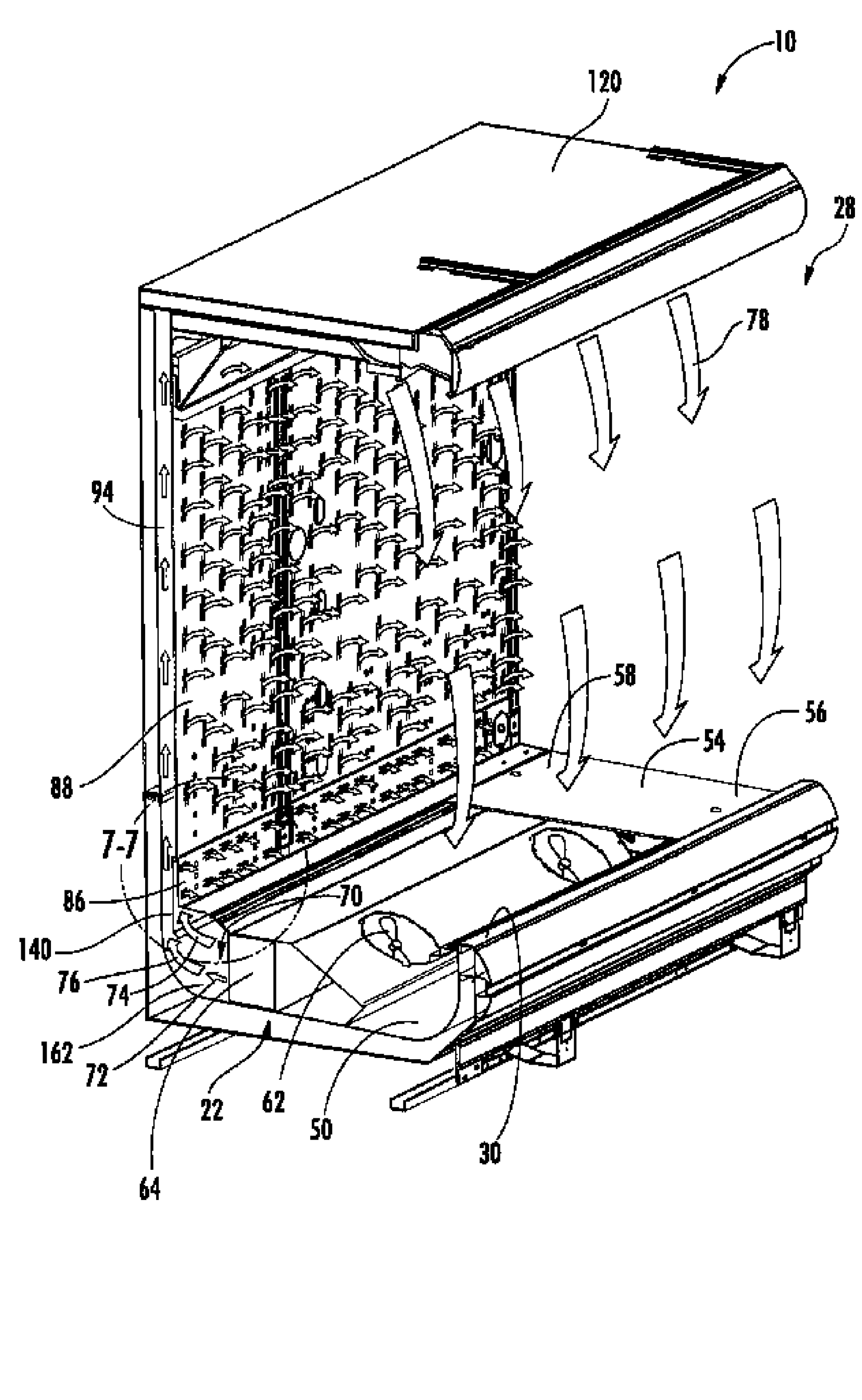
(57) **ABSTRACT**

A temperature-controlled case is provided including a rear wall spaced apart from an intermediate wall, forming a cavity therebetween. The intermediate wall includes a first set of openings disposed below a second set of openings. A deck may be disposed proximate to the first set and the shelves proximate to the second set of openings. Each shelf may include a shelf base and cover, the cover having openings through which air may be directed. An air distribution system having an air diverting device provides for improved air flow and cooling of products within the case. The air diverting device directs a first portion of an air flow toward the deck and permits a second portion to be directed toward the shelves. The air diverting device may direct the first portion of the air flow through the cavity and towards the deck, or away from the cavity and towards the deck.

19 Claims, 17 Drawing Sheets



(56) **References Cited**

U.S. PATENT DOCUMENTS

4,299,099	A	11/1981	Myers et al.	
4,514,988	A	5/1985	Ibrahim	
4,592,209	A *	6/1986	Casanova et al.	62/255
4,750,335	A	6/1988	Wallace et al.	
4,765,150	A	8/1988	Persem	
4,938,034	A	7/1990	Rosanio et al.	
RE33,620	E	6/1991	Persem	
5,048,303	A	9/1991	Campbell et al.	
5,228,581	A	7/1993	Palladino et al.	
5,357,767	A	10/1994	Roberts	
5,475,987	A	12/1995	McGovern	
5,475,988	A	12/1995	McGovern	
5,606,863	A	3/1997	Kicklighter et al.	
5,644,831	A	7/1997	Federico	
5,675,983	A	10/1997	Ibrahim	
5,755,108	A	5/1998	Ibrahim et al.	
5,924,297	A	7/1999	Wolff et al.	
6,094,925	A	8/2000	Arshansky et al.	
6,094,931	A *	8/2000	Jeong	62/407
6,151,904	A	11/2000	Jin	
6,170,270	B1	1/2001	Arshansky et al.	
6,185,951	B1	2/2001	Lane et al.	
6,360,548	B1	3/2002	Navarro	
6,381,976	B1	5/2002	Kempiak et al.	
6,405,548	B1	6/2002	Hollenbeck	
6,431,060	B1	8/2002	Gutheim	
6,519,962	B1	2/2003	Schuetter	
6,539,741	B2	4/2003	Navarro	
6,694,757	B1	2/2004	Backman	
6,708,511	B2	3/2004	Martin	
6,722,149	B1	4/2004	Saroka et al.	
6,742,344	B2	6/2004	Vormedal	
6,745,344	B1	6/2004	Joshi et al.	
6,745,588	B2	6/2004	Kahler	
6,827,463	B2	12/2004	Chuang et al.	
6,851,271	B2	2/2005	Upton et al.	
6,883,343	B2	4/2005	Lane et al.	
6,889,514	B2	5/2005	Lane et al.	
6,889,518	B2	5/2005	Lane et al.	
6,912,864	B2	7/2005	Roche et al.	
6,915,652	B2	7/2005	Lane et al.	
6,955,061	B2	10/2005	Chiang et al.	
6,959,560	B2	11/2005	Weikel et al.	
6,981,385	B2	1/2006	Arshansky et al.	
6,993,925	B2	2/2006	Duffy	
7,010,924	B2	3/2006	Kempiak	
7,036,947	B2	5/2006	Chuang et al.	
7,065,979	B2	6/2006	Arshansky et al.	
7,121,104	B2	10/2006	Howington et al.	
7,159,413	B2	1/2007	Dail	
7,216,500	B2	5/2007	Schwichtenberg et al.	
7,275,376	B2	10/2007	Swofford et al.	
7,357,000	B2	4/2008	Schwichtenberg et al.	
7,497,770	B2	3/2009	Grassmuck et al.	
2001/0042383	A1	11/2001	Chiang et al.	
2001/0042384	A1	11/2001	Chiang et al.	
2002/0162346	A1	11/2002	Chiang et al.	
2002/0184904	A1	12/2002	Wellman	
2003/0159451	A1	8/2003	Nash, Jr.	
2004/0055321	A1	3/2004	Kempiak	
2004/0244396	A1	12/2004	Lane et al.	
2005/0039483	A1	2/2005	Yun et al.	
2005/0126196	A1	6/2005	Grassmuck et al.	
2005/0132744	A1	6/2005	Rohrer et al.	
2005/0138943	A1	6/2005	Alahyari et al.	
2005/0144966	A1	7/2005	Upton et al.	
2005/0150241	A1	7/2005	Upton et al.	
2005/0193755	A1	9/2005	Duffy	
2006/0042288	A1	3/2006	Downs	
2006/0242980	A1	11/2006	Duffy et al.	
2007/0006604	A1	1/2007	Behr	
2007/0289323	A1	12/2007	Swofford et al.	
2008/0271473	A1	11/2008	Fung et al.	
2008/0282719	A1	11/2008	Fung	
2009/0044553	A1	2/2009	Tilley	
2009/0084125	A1	4/2009	Fung	
2009/0205351	A1	8/2009	Fung	
2009/0215381	A1	8/2009	Swofford	
2009/0223237	A1	9/2009	Grassmuck et al.	
2010/0058789	A1	3/2010	Barreto et al.	
2010/0212343	A1	8/2010	Swofford et al.	

OTHER PUBLICATIONS

PCT International Search Report relating to International Application No. PCT/US05/44177, date of mailing of the International Search Report, Apr. 7, 2006, 1 page.

PCT Written Opinion of the International Search Authority relating to International Application No. PCT/US05/44177, date of completion of this opinion, Mar. 20, 2006, 3 pages.

* cited by examiner

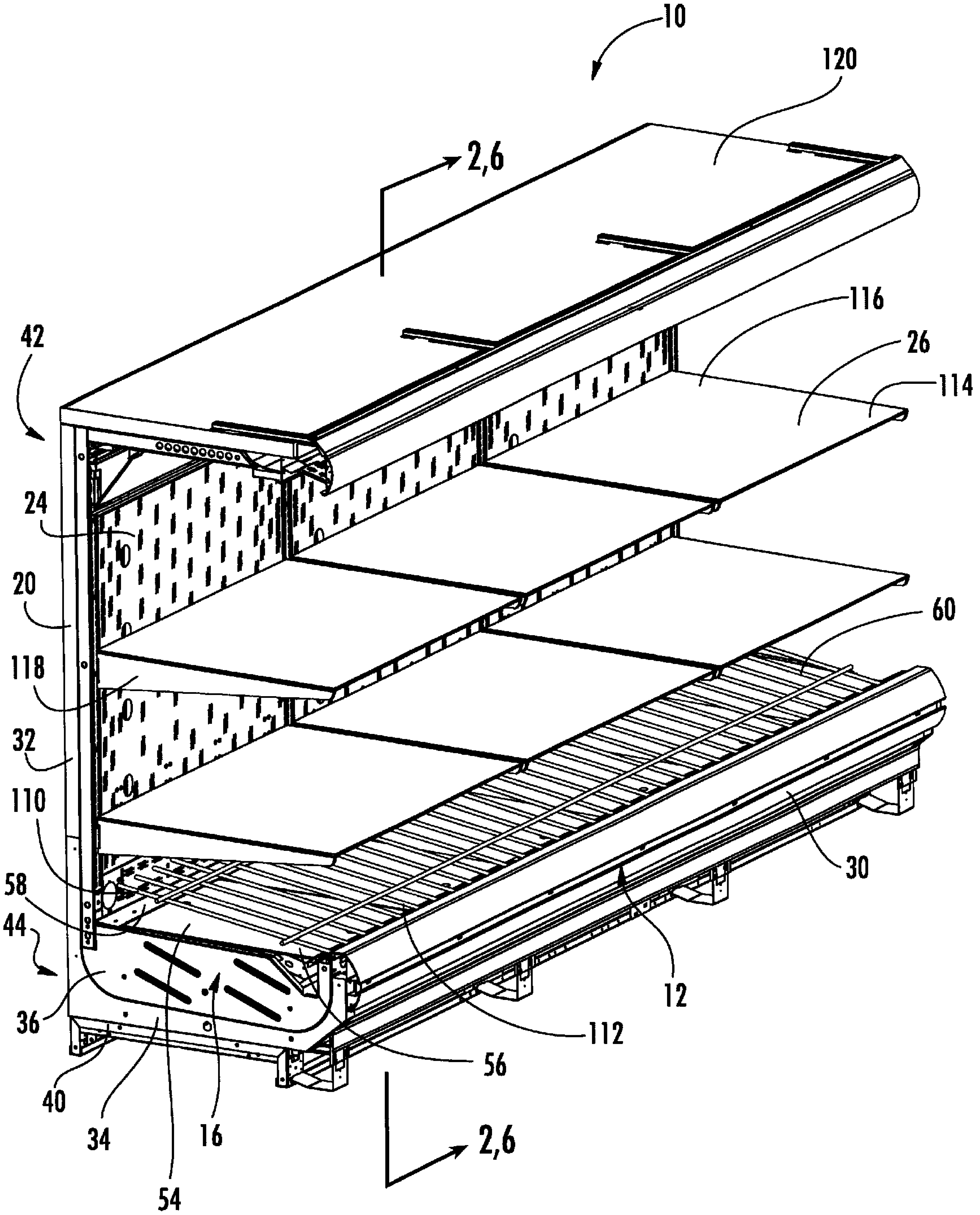

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FIG. 1A

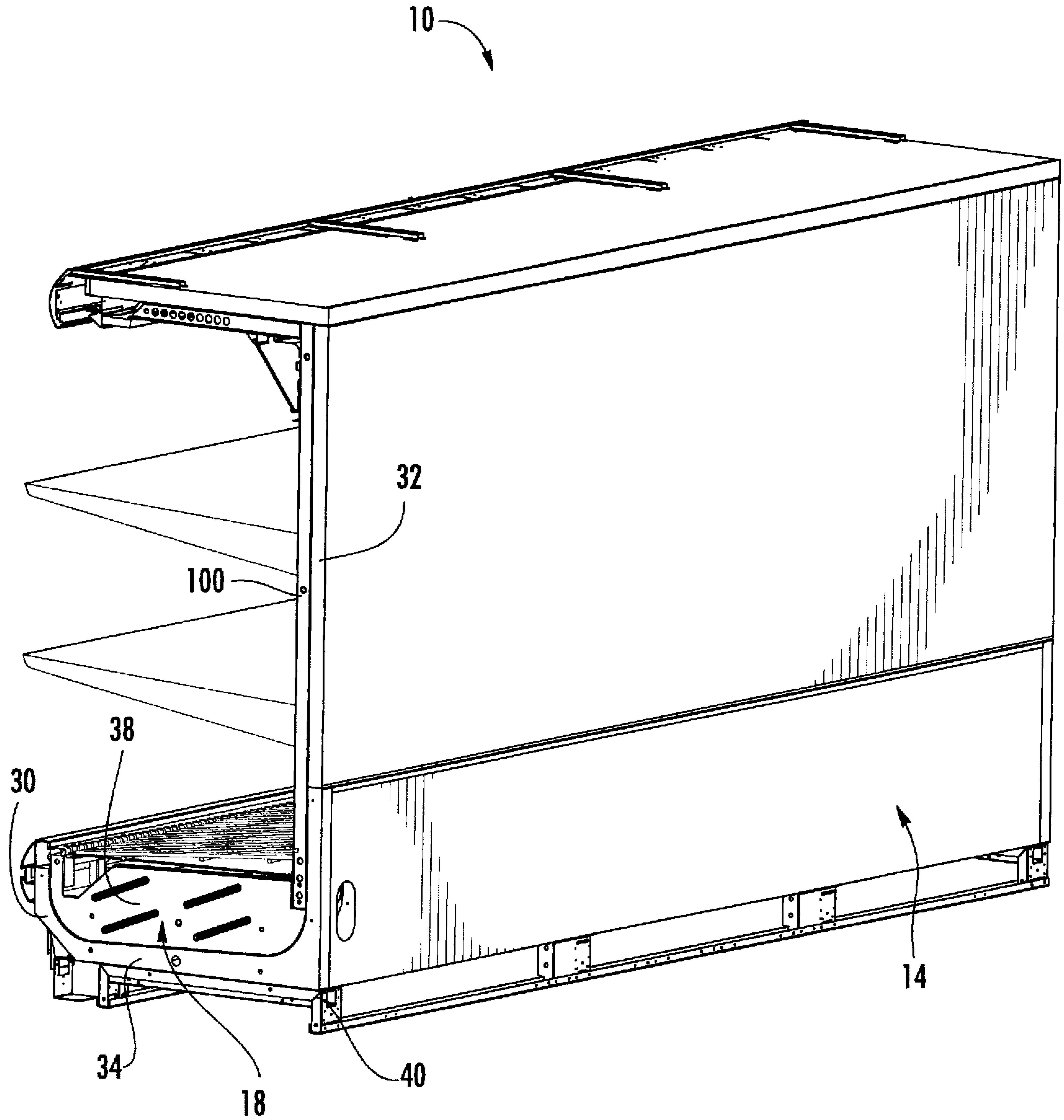

FIG. 1B

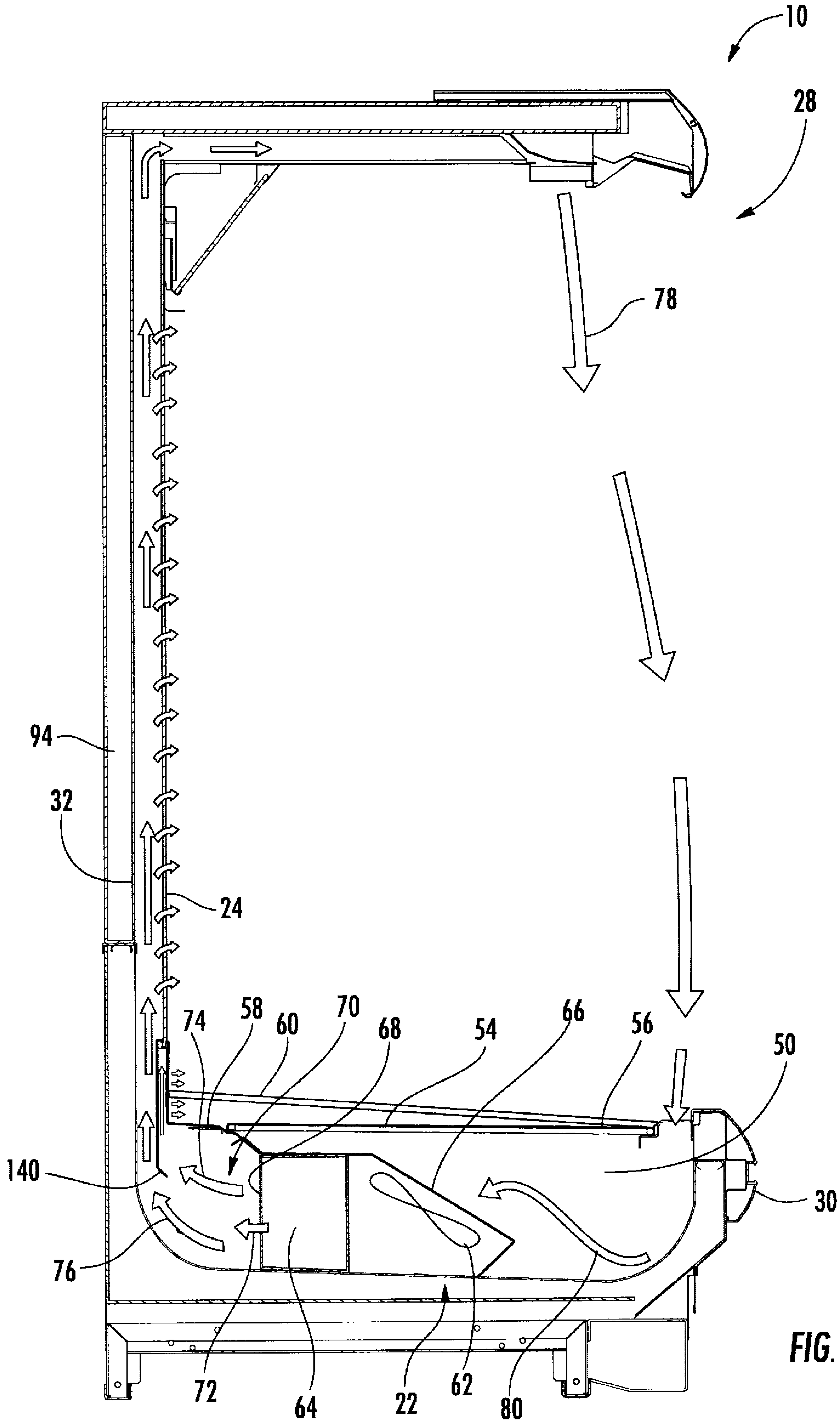

FIG. 2

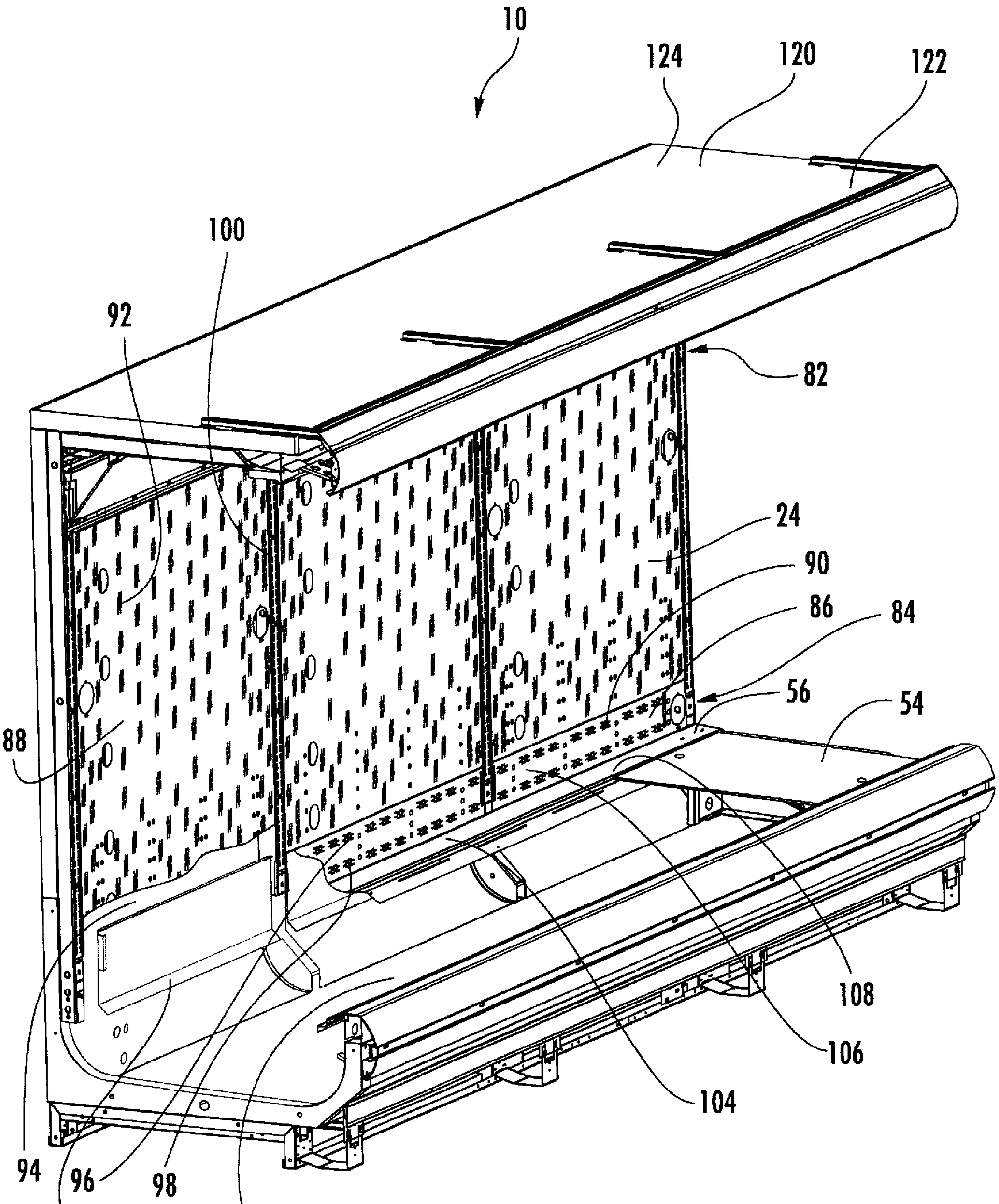
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FIG. 3

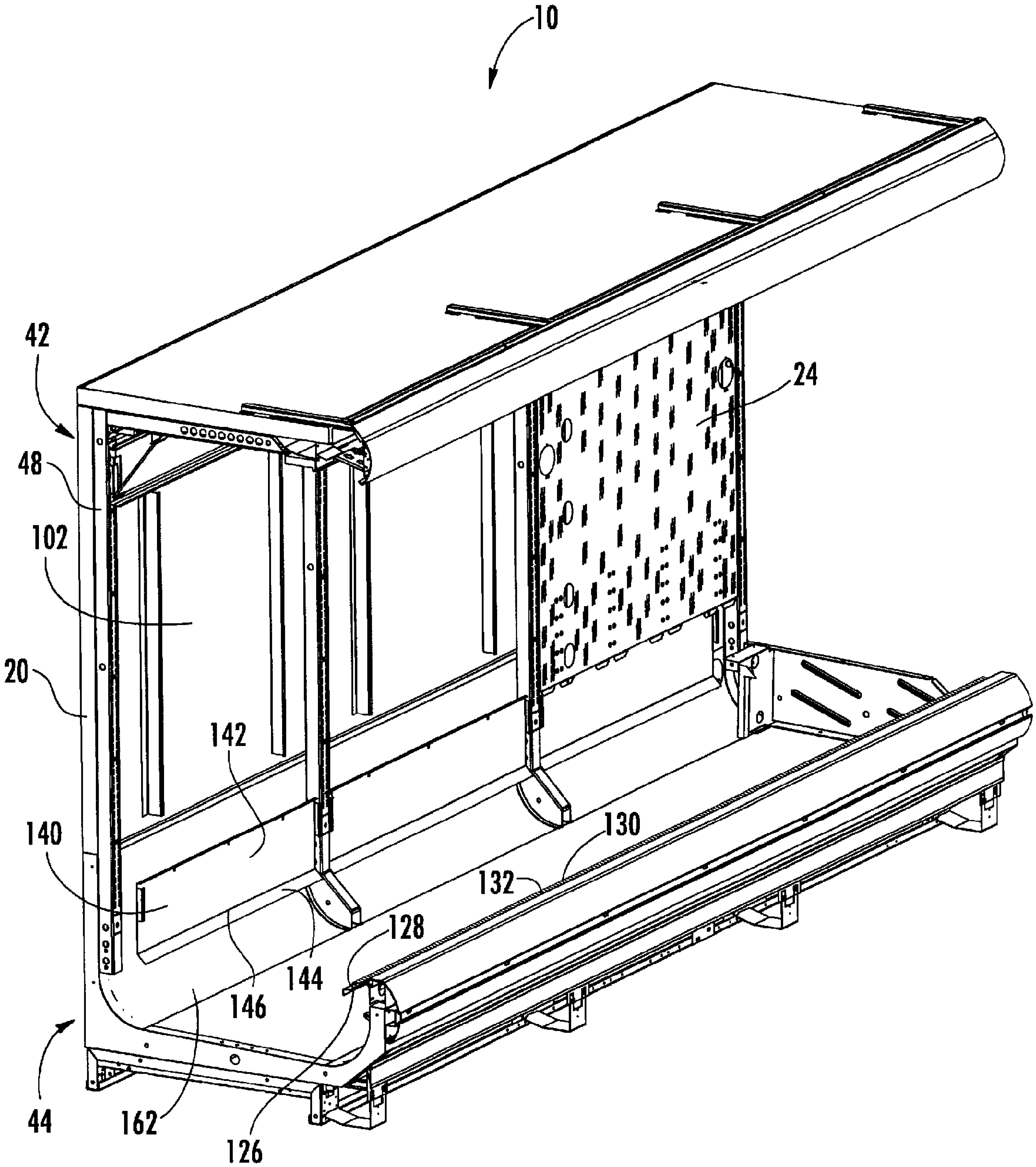

FIG. 4

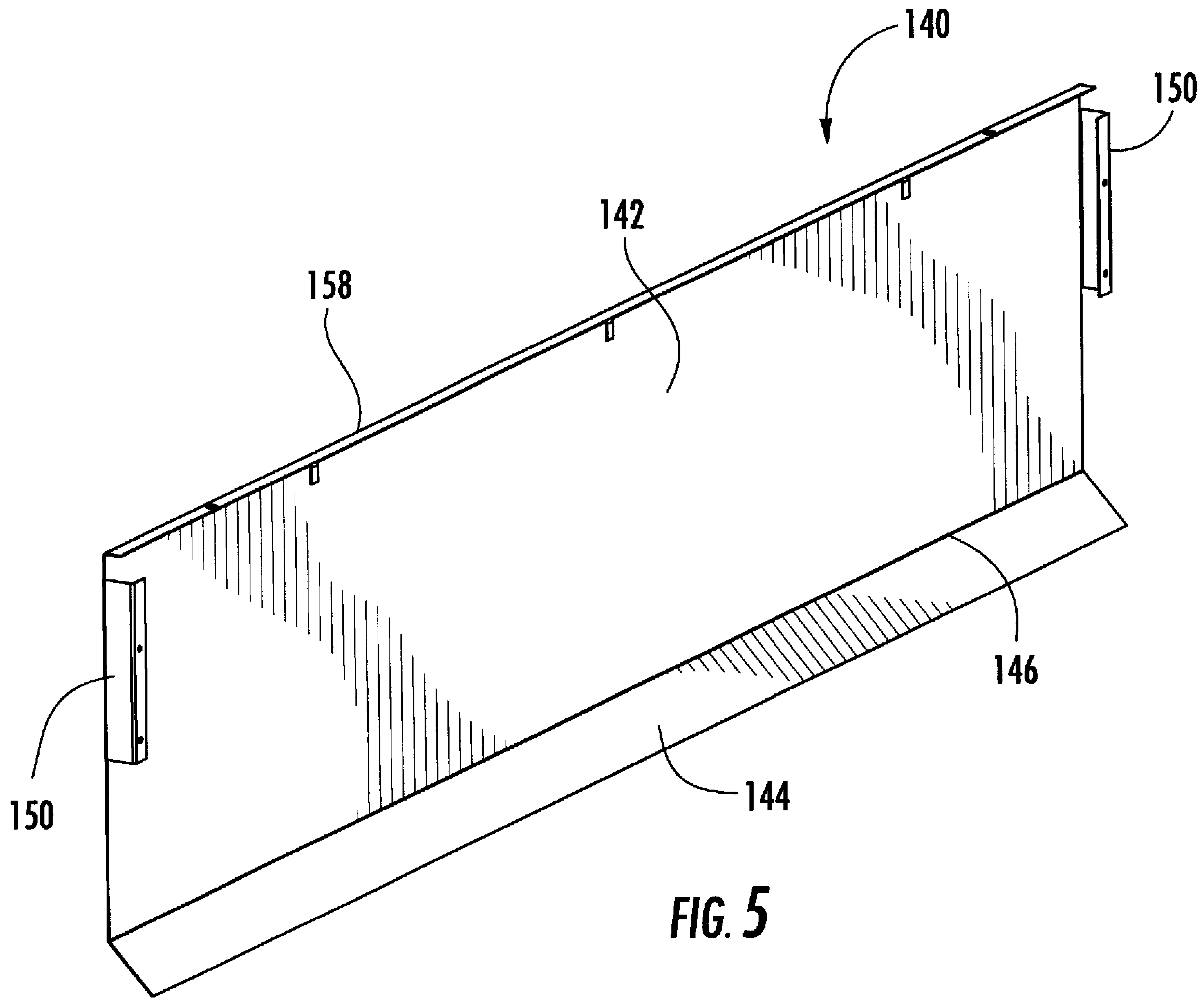

FIG. 5

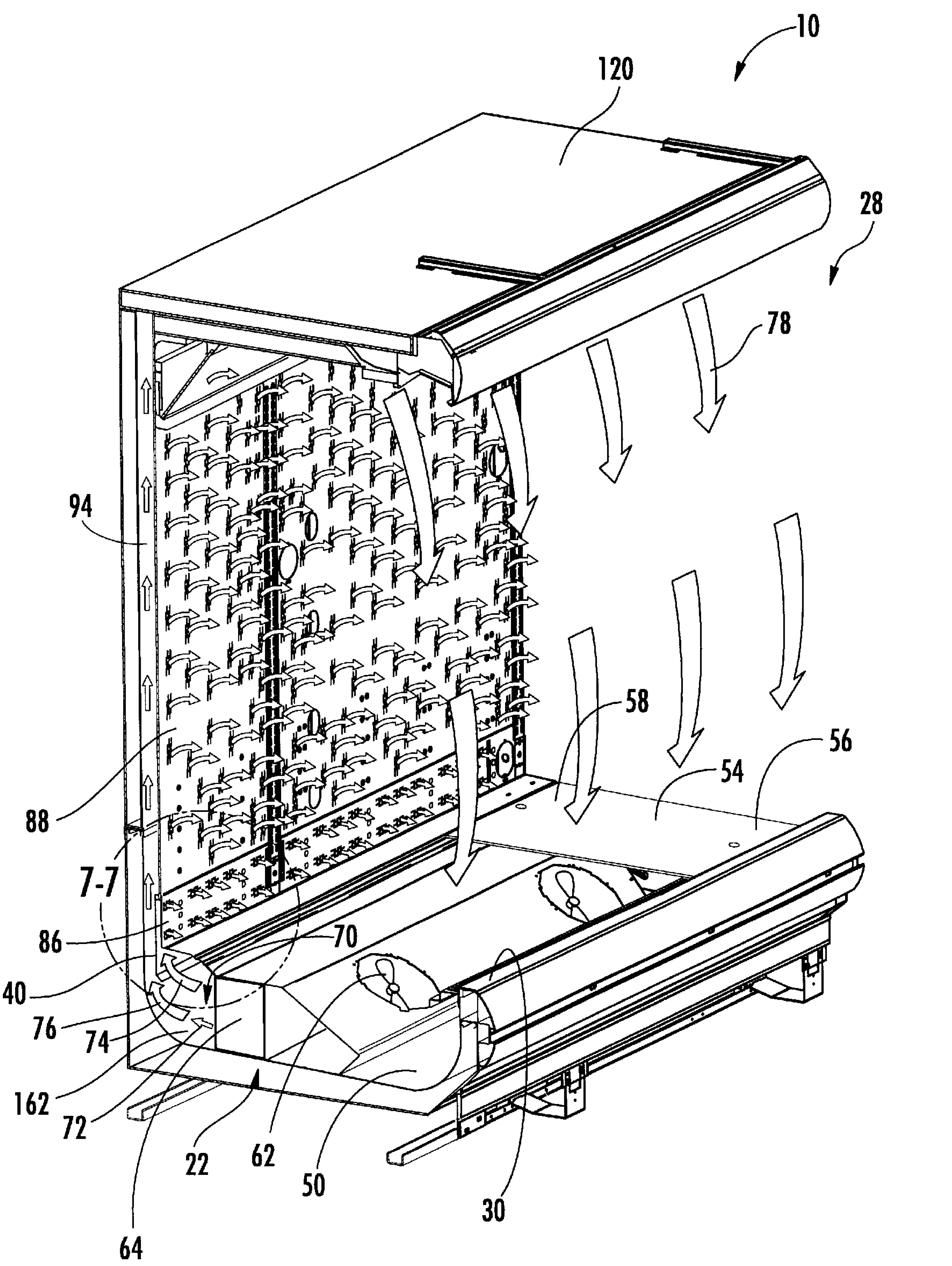

FIG. 6

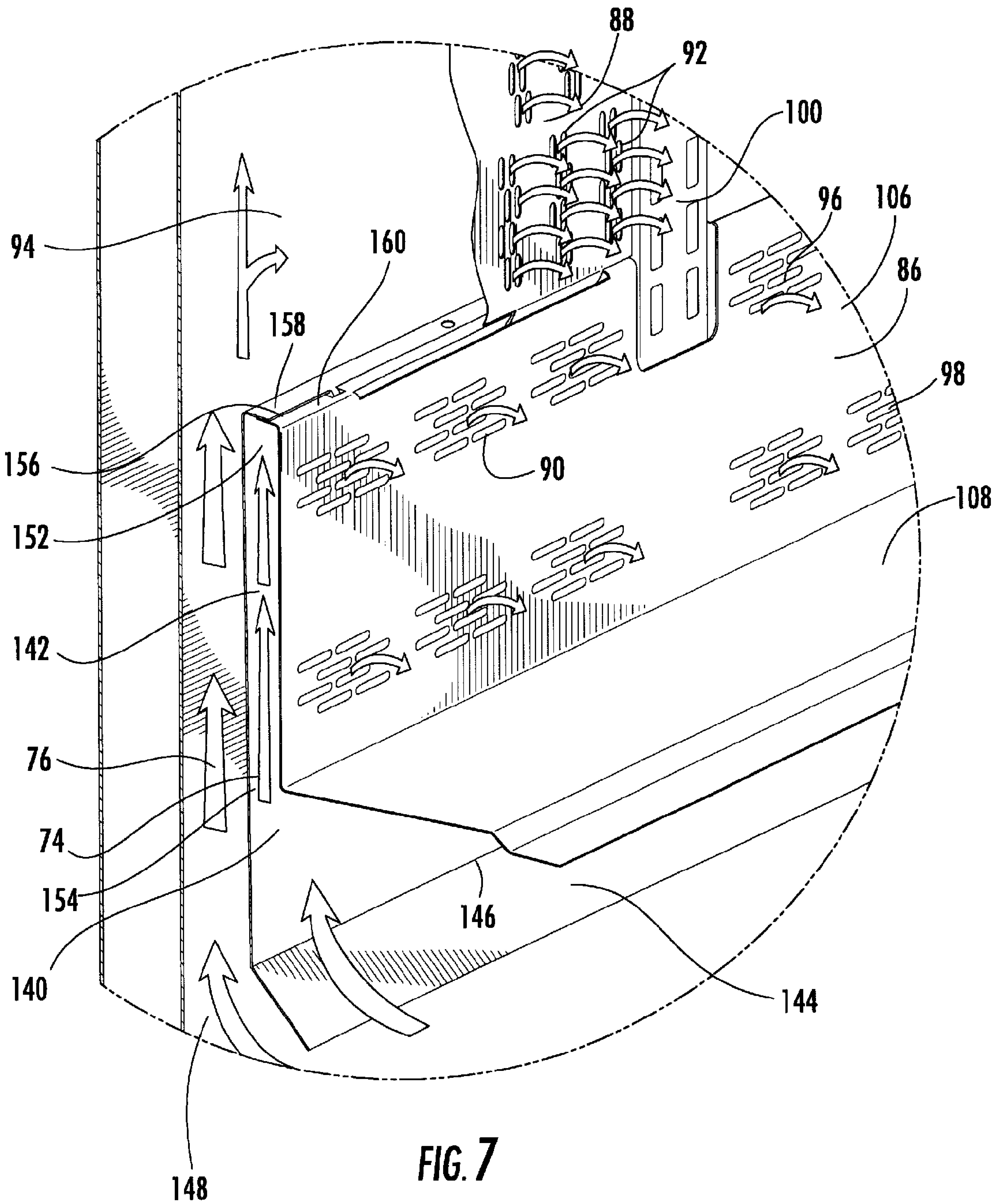
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FIG. 7

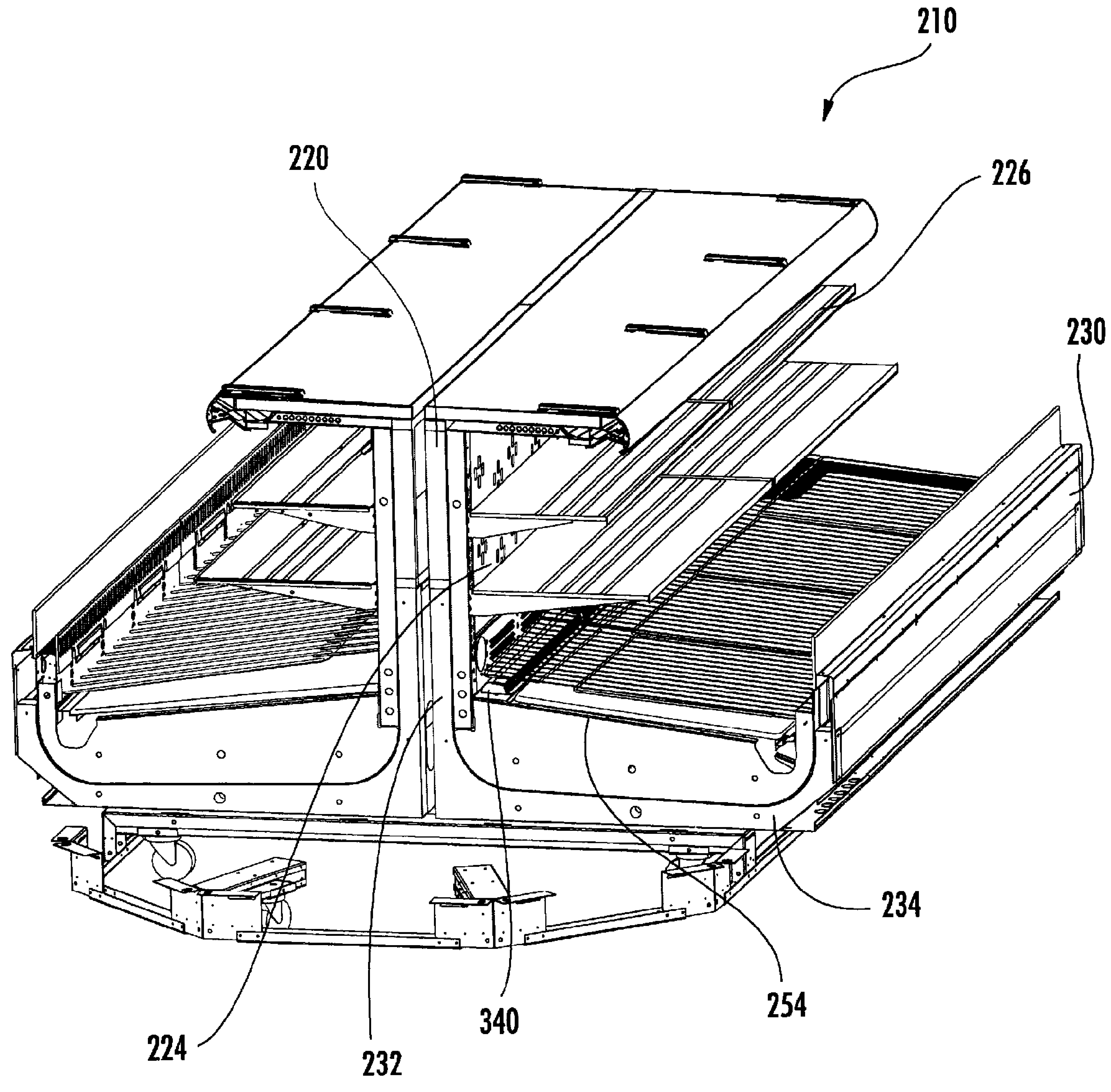

FIG. 8A

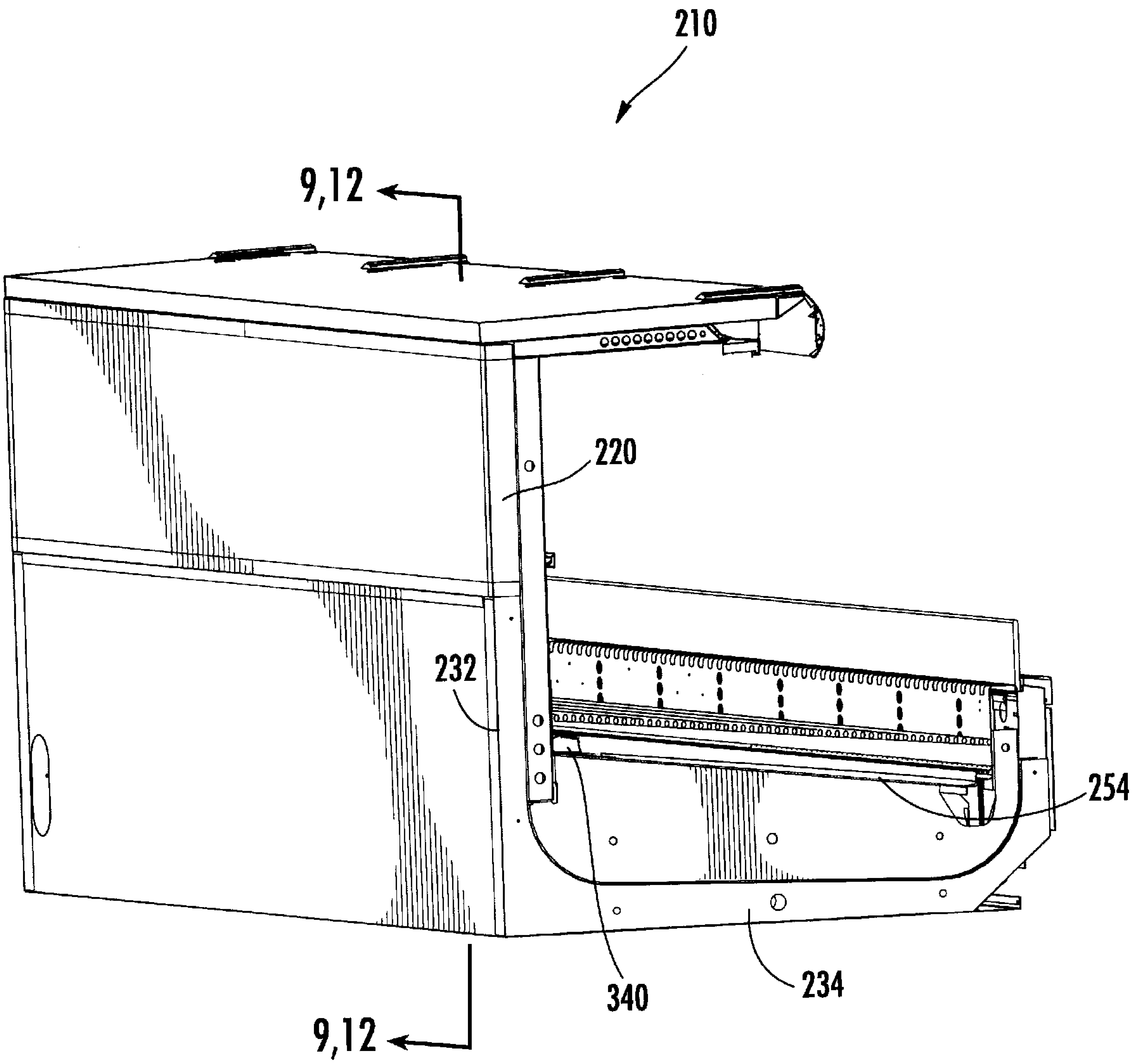

FIG. 8B

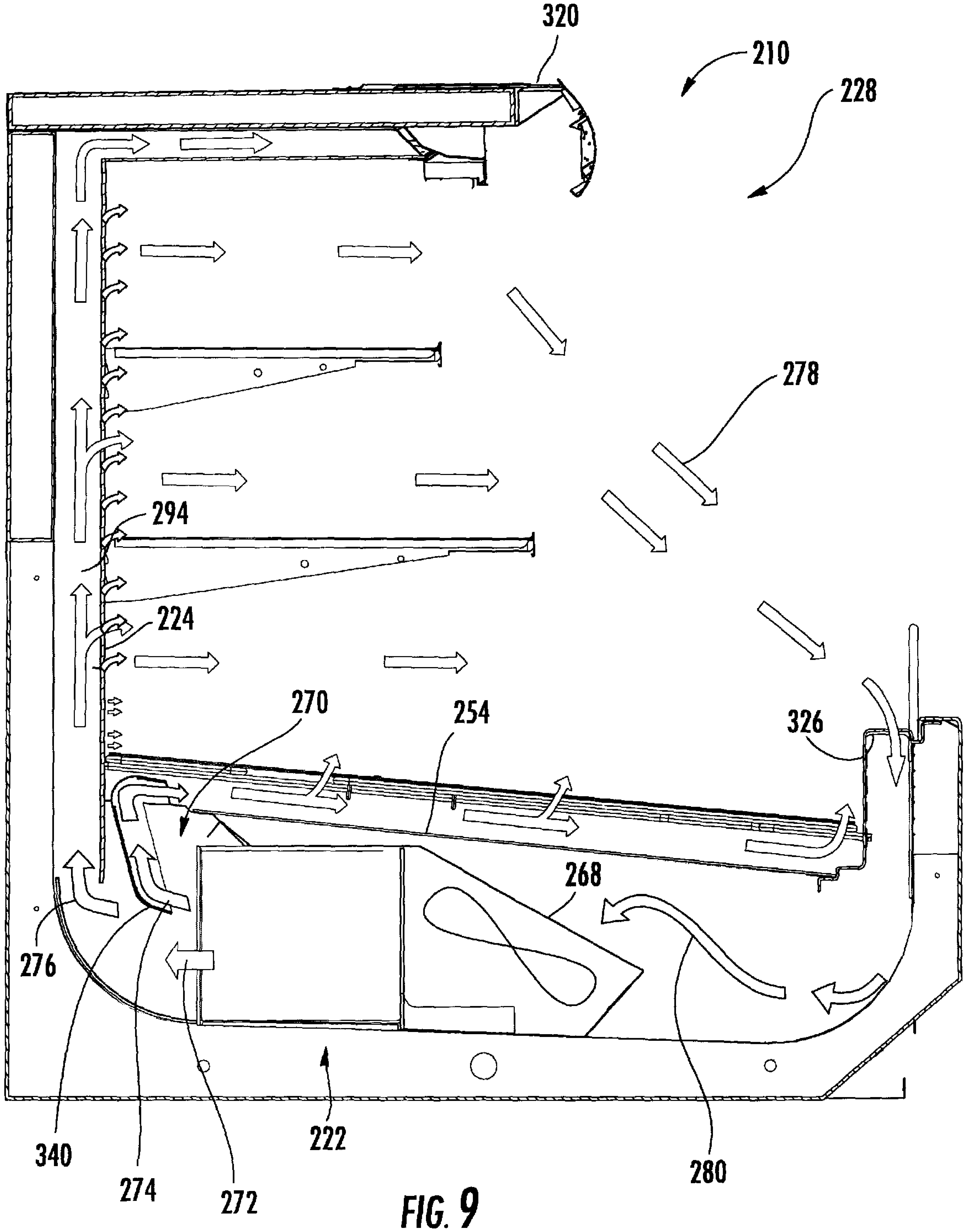

FIG. 9

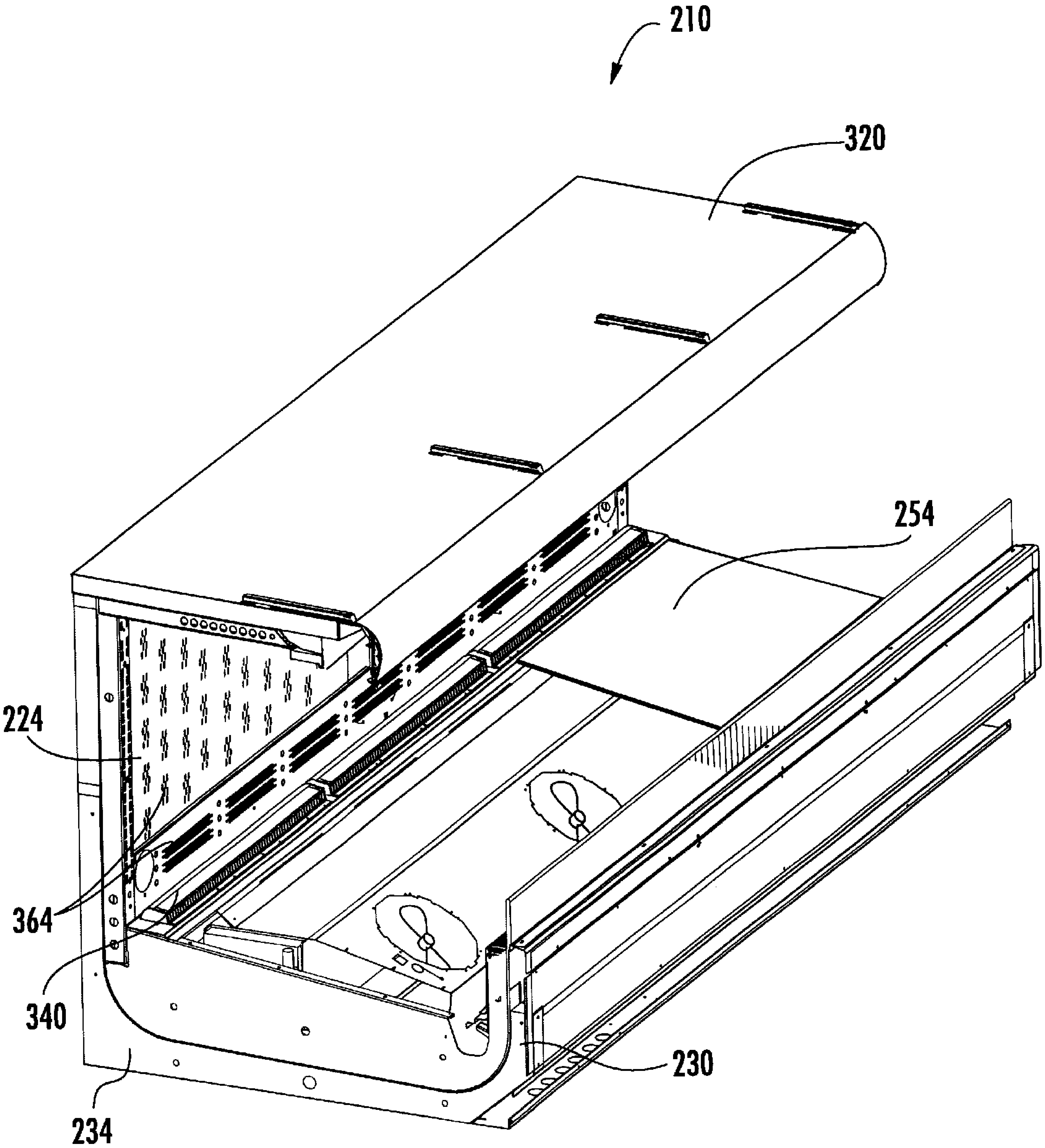

FIG. 10

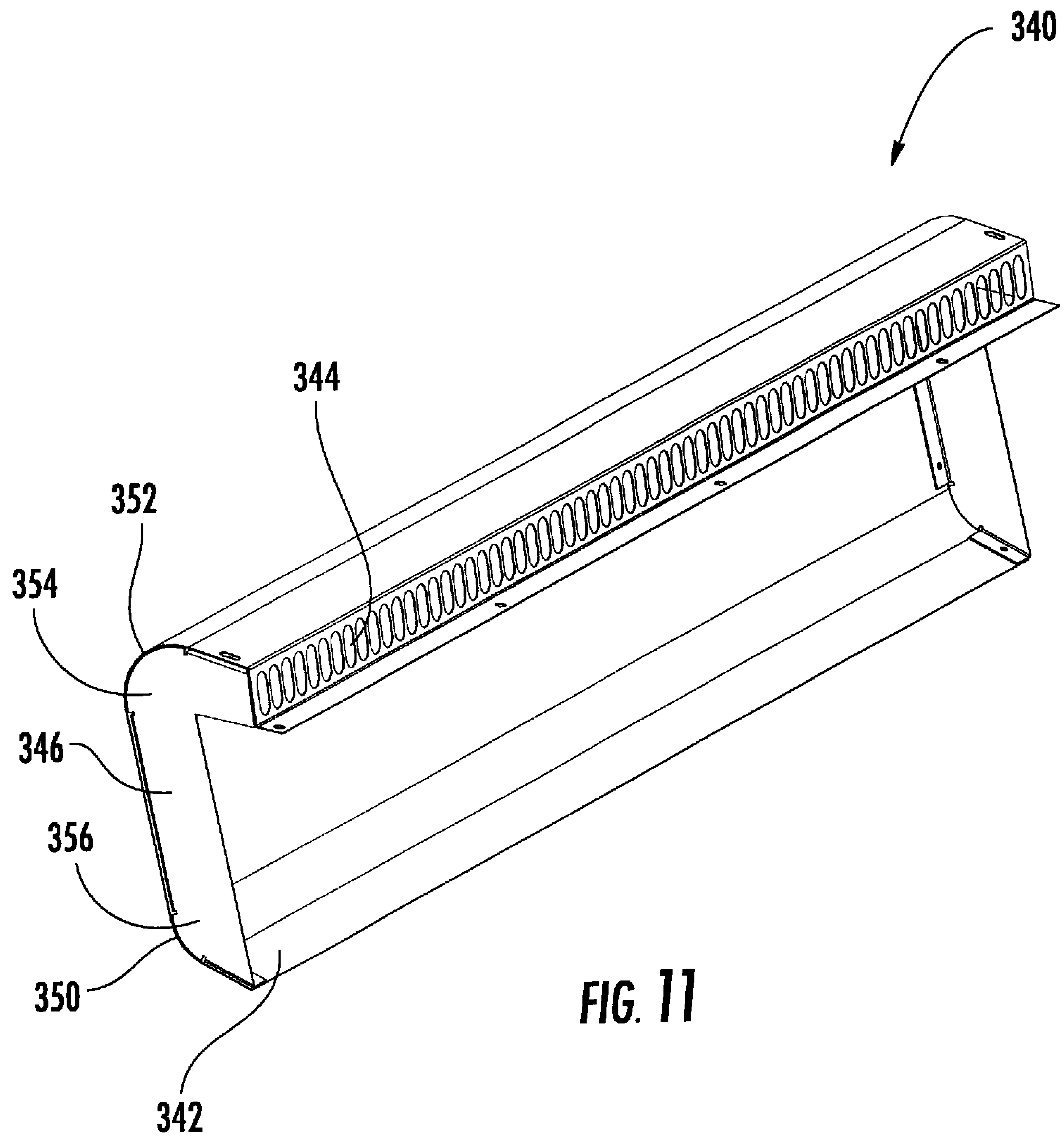

FIG. 11

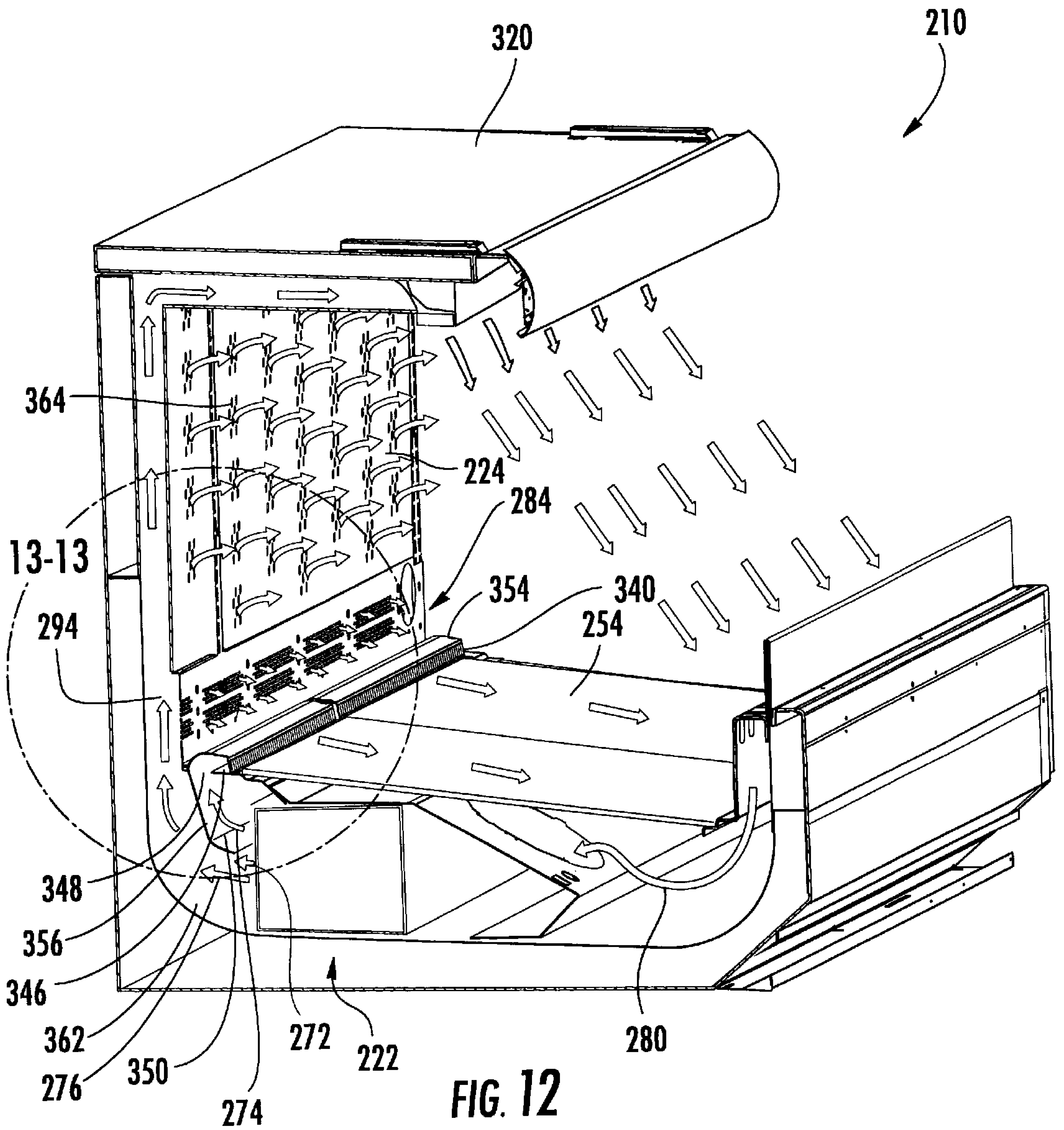
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FIG. 12

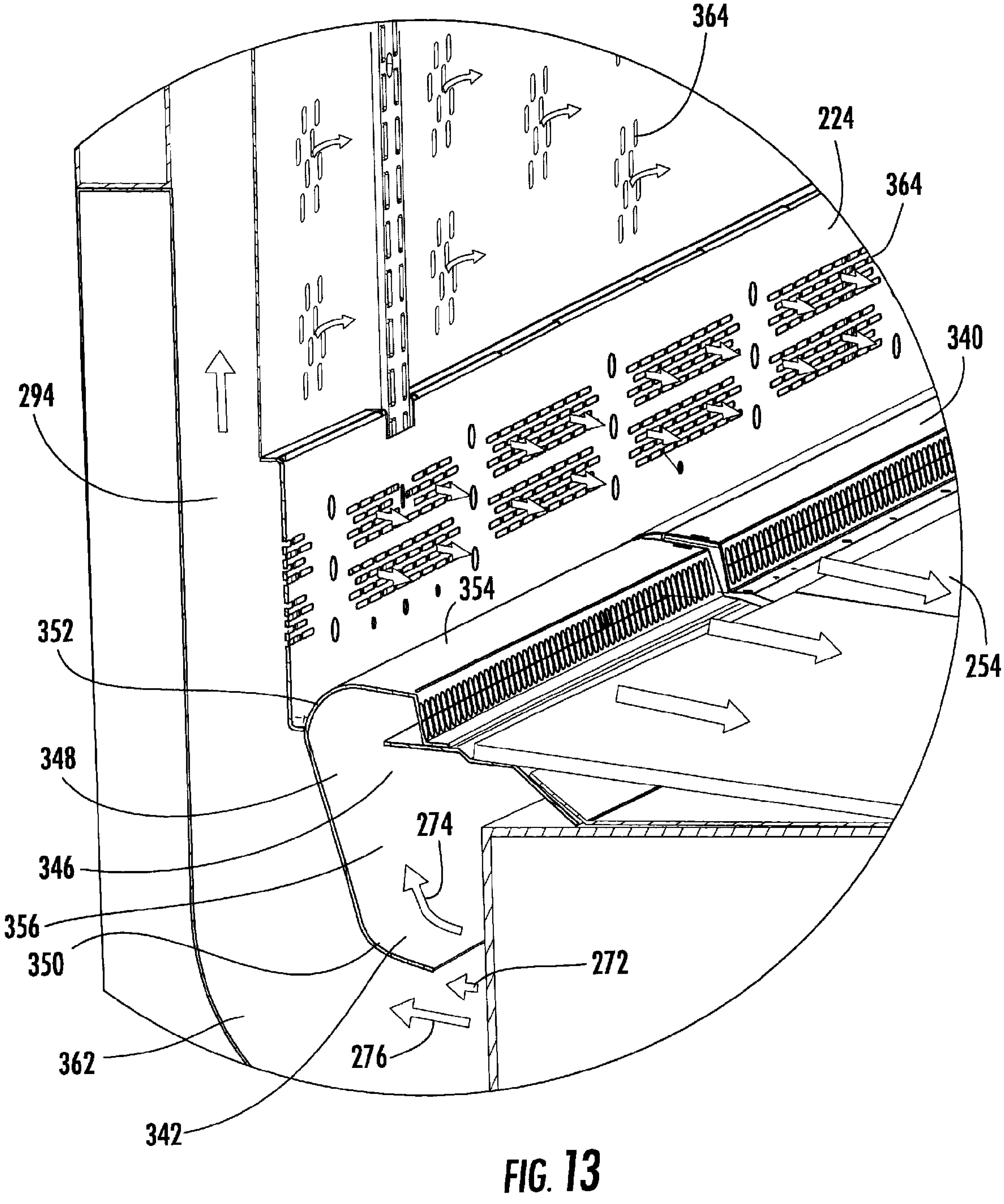
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FIG. 13

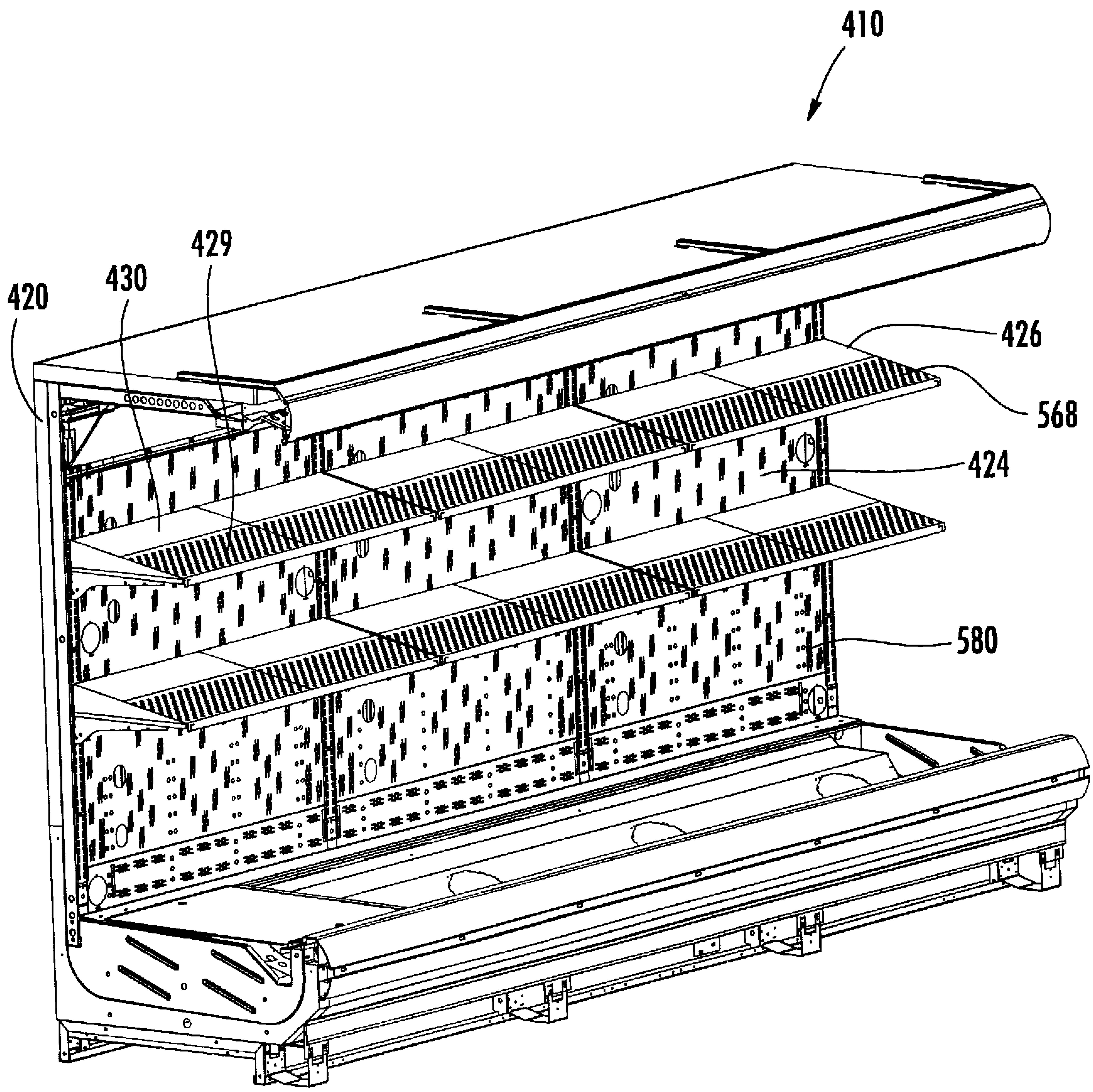

FIG. 14

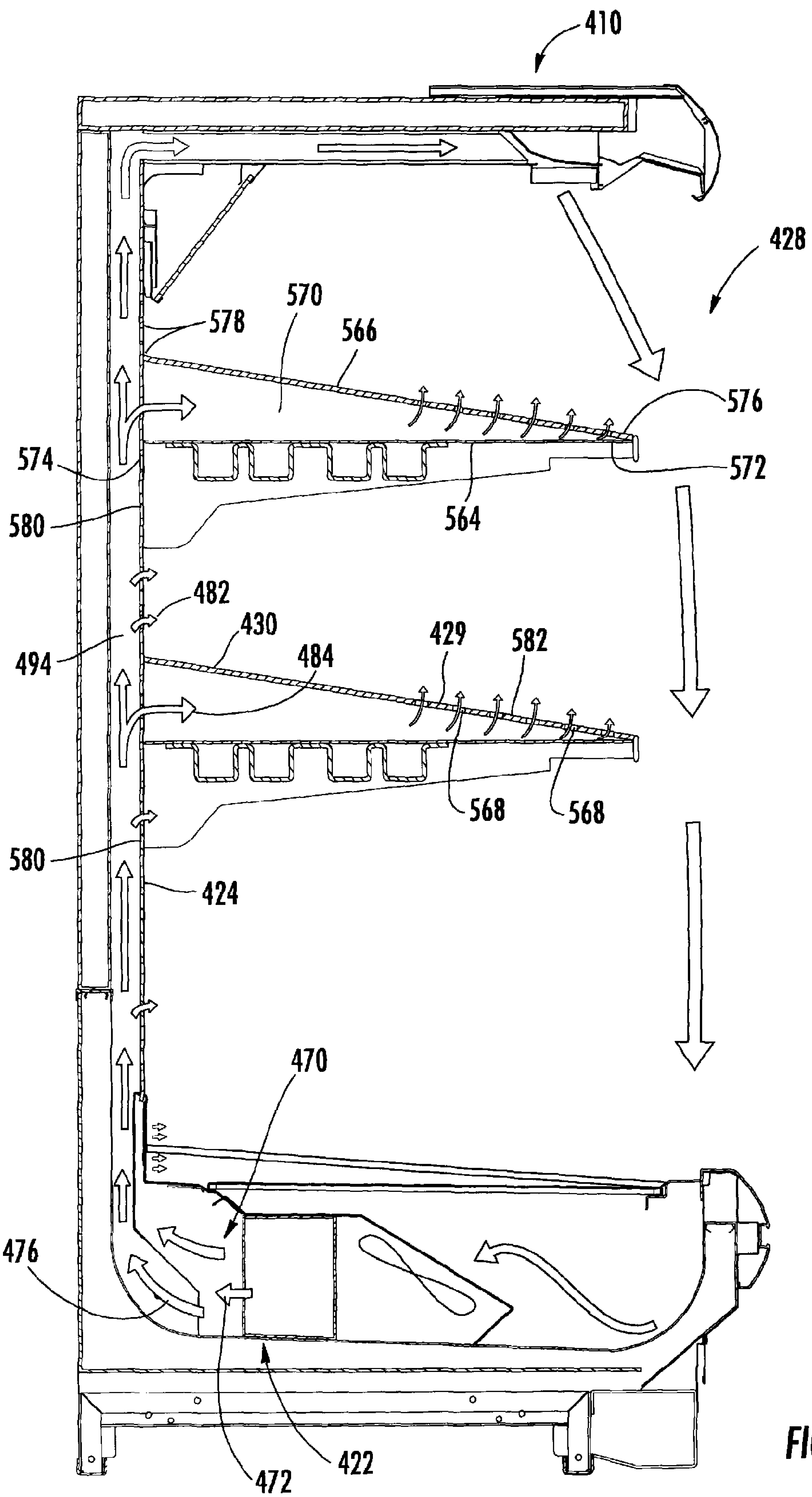
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FIG. 15

AIR DISTRIBUTION SYSTEM FOR TEMPERATURE-CONTROLLED CASE

CROSS REFERENCE TO RELATED APPLICATIONS

This application claims the benefit of priority under 35 U.S.C. §119(e) of U.S. Provisional Patent Application No. 61/185,890, having a filing date of Jun. 10, 2009, titled "Air Distribution System for Temperature-Controlled Case," the complete disclosure of which is hereby incorporated by reference.

BACKGROUND

It is well known to provide a temperature-controlled display case such as a refrigerator, freezer, refrigerated merchandiser, refrigerated display case, etc., that may be used in commercial, institutional, and residential applications for storing or displaying refrigerated or frozen objects. For example, it is known to provide refrigerated display cases or merchandisers having an air circulation or distribution system for distributing air chilled by a cooling element throughout a display space within the case or merchandiser to maintain products at a desired temperature. However, such known air distribution systems in refrigerated display cases and merchandisers tend to result in uneven air distribution and varying temperatures for the products stored within the case. A temperature-controlled case having an improved air distribution system is provided.

SUMMARY

According to one embodiment a temperature-controlled case comprises a rear wall, a front wall, an air flow device, and an air outlet disposed at least partially between the rear wall and the front wall. The air flow device is configured to provide an air flow discharged through the air outlet. An intermediate wall is spaced apart from the rear wall to define a cavity. The intermediate wall includes a first plurality of openings and second a plurality of openings disposed substantially above the first plurality of openings. The temperature-controlled case further comprises at least one air diverting device. The air diverting device is configured to receive and direct a first portion of the air flow through the first plurality of openings and to permit a second portion of the air flow to be directed through the second plurality of openings.

According to another embodiment, a temperature-controlled case comprises a rear wall, a front wall, a deck having a front portion and a rear portion, and an air flow device configured to provide an air flow. An intermediate wall is spaced apart from the rear wall to define a cavity. At least one shelf includes a front portion and a rear portion. The rear portion of the shelf is disposed adjacent to the intermediate wall. At least one air diverting device is configured to receive and direct a first portion of the air flow through the cavity and toward the deck and to permit a second portion of the air flow to be received in the cavity and be directed toward the shelf.

According to another embodiment, a temperature-controlled case comprises a front wall, a rear wall, and a deck. The deck extends at least partially between the front wall and the rear wall. An air flow device is disposed beneath the deck and is configured to provide an air flow. An intermediate wall is spaced apart from the rear wall to define a cavity. The intermediate wall includes a plurality of openings. At least one shelf includes a front portion and a rear portion. The rear portion of the shelf is disposed adjacent to the intermediate

wall. At least one air diverting device is configured to receive and direct a first portion of the air flow away from the cavity and toward the deck and configured to permit a second portion to be received in the cavity and directed toward the shelf.

According to another embodiment, a temperature-controlled case comprises a front wall, a rear wall, and a deck. The deck extends at least partially between the front wall and the rear wall. An air flow device is disposed beneath the deck and is configured to provide an air flow. An intermediate wall is spaced apart from the rear wall to define a cavity. The intermediate wall includes a plurality of openings. A plurality of shelves each include a front portion and a rear portion. The rear portion of each shelf is disposed adjacent to the intermediate wall. At least one of the plurality of shelves includes a shelf base, a shelf cover, and a space defined therebetween. The shelf cover includes a plurality of openings at the front portion of the shelf. The air flow is directed in a first flow path toward the rear portion of the at least one shelf and directed in a second flow path through the space toward the openings in the front portion of the at least one shelf.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1**A is a front perspective view of a temperature-controlled case according to a first exemplary embodiment.

FIG. **1**B is a rear perspective view of the exemplary embodiment of a temperature-controlled case of FIG. **1**A.

FIG. **2** is a side plan, cross-sectional view of the exemplary embodiment of a temperature-controlled case of FIG. **1**A along line **2**-**2**, illustrating the air flow.

FIG. **3** is a perspective view of the exemplary embodiment of a temperature-controlled case of FIG. **1**A.

FIG. **4** is a perspective view of the exemplary embodiment of a temperature-controlled case of FIG. **1**A.

FIG. **5** is a perspective view of a scoop of the exemplary embodiment of a temperature-controlled case of FIG. **1**A.

FIG. **6** is a perspective cross-sectional view of the exemplary embodiment of a temperature-controlled case of FIG. **1**A along the line **6**-**6**.

FIG. **7** is a detailed view of FIG. **6** taken along the line **7**-**7**.

FIG. **8**A is a front perspective view of a temperature-controlled case according to a second exemplary embodiment.

FIG. **8**B is a rear perspective view of the exemplary embodiment of a temperature-controlled case of FIG. **8**A.

FIG. **9** is a side plan, cross-sectional view of the exemplary embodiment of a temperature-controlled case of FIG. **8**A along line **9**-**9**, illustrating the air flow.

FIG. **10** perspective view of the exemplary embodiment of a temperature-controlled case of FIG. **8**A.

FIG. **11** is a perspective view of a scoop of the exemplary embodiment of a temperature-controlled case of FIG. **8**A.

FIG. **12** is a perspective cross-sectional view of the exemplary embodiment of a temperature-controlled case of FIG. **8**A along the line **12**-**12** illustrating the air flow.

FIG. **13** is a detailed view of FIG. **12** taken along line **13**-**13**.

FIG. **14** is a front perspective view of a temperature-controlled case having shelves according to a third embodiment.

FIG. **15** is a perspective cross-sectional view of the exemplary embodiment of a temperature-controlled case of FIG. **14** along line **15**-**15** and illustrating the air flow through the shelf.

DETAILED DESCRIPTION

Referring to the FIGURES, various embodiments of a temperature-controlled case shown as a refrigerated case **10** are disclosed. According to the embodiments shown, refrigerated case **10** is a "straight" portion of an island-type case. Refrigerated case **10** is further shown as a front-loading, open-front type case (e.g., "reach-in," "self-service," etc.). Accordingly, refrigerated case **10** includes a front **12** that is open and a rear **14**. Refrigerated case **10** is configured to be coupled or disposed proximate to the back of another straight portion of an island-type case at rear **14** (see, e.g., FIG. **8**A illustrating two refrigerated cases **10** disposed back-to-back). Alternatively, rear **14** may be aligned proximate a wall in the space in which refrigerated case **10** is located. Refrigerated case **10** may be further configured to be coupled to an "end" portion of an island-type case at one or both of its sides, first side **16** and second side **18**. While the temperature-controlled case is shown as a refrigerated case, the temperature-controlled case may also be a heated case. Further, concepts disclosed herein may be applied to any of a variety of temperature-controlled cases (e.g., an end portion of an island-type case, a rear-loading case, etc.).

Referring to FIGS. **1**A and **1**B, refrigerated case **10** is shown according to an exemplary embodiment including a frame **20**, a cooling system **22** (see, e.g., FIG. **2** illustrating cooling system **22**), an intermediate wall **24**, a plurality of shelves **26**, and an air distribution system **28** (see, e.g., FIG. **2** illustrating air distribution system **28**). Refrigerated case **10** displays and/or stores products (e.g., food products, etc.). Refrigerated case **10** is configured to maintain products displayed and/or stored therein at a constant temperature. Air distribution system **28** provides for enhanced air flow and cooling within refrigerated case **10**. Further, air distribution system **28** provides for a more balanced cooling profile to maintain products at a more uniform temperature (e.g., products located at various locations within the temperature-controlled case are maintained at substantially the same temperature).

Frame **20** includes a front wall **30**, rear wall **32**, a bottom wall **34** extending substantially between front wall **30** and rear wall **32**, a first side wall **36**, and a second side wall **38** according to an exemplary embodiment. Frame **20** provides stability and support for refrigerated case **10** and in part defines the product display space within refrigerated case **10**. Bottom wall **34** is generally disposed on or near the ground or floor of a room or space in which refrigerated case **10** is located (e.g., a grocery store, a convenience store, a personal residence, etc.). A support structure **40** may be disposed at least partially below bottom wall **34** to raise frame **20** a distance above the ground. Rear wall **32** of frame **20** substantially corresponds to rear **14** of refrigerated case **10** and may be coupled to another temperature-controlled case (e.g., another straight portion of an island-type case, etc.) to form a larger case (e.g., an island-type case). Rear wall **32** includes a top **42** and a bottom **44**. Rear wall **32** is shown extending substantially vertically to a height greater than the height to which front wall **30** extends substantially vertically. Rear wall **32** is further shown substantially opposite front wall **30**. First side wall **36** is shown substantially opposite second side wall **38**. First side wall **36** and second side wall **38** in part define a cavity **50** (see, e.g., FIG. **2** illustrating cavity **50**).

Referring further to FIGS. **1**A and **1**B, frame **20** further includes a deck **54** configured to provide a product support surface according to an exemplary embodiment. Deck **54** is shown disposed substantially above and spaced a distance from bottom wall **34** of frame **20**, at least partially defining cavity **50**. Deck **54** is further shown extending substantially horizontally and at least partially between intermediate wall **24** and front wall **30**. Deck **54** includes a front portion **56** proximate front wall **30** and a rear portion **58** proximate intermediate wall **24**. A grate **60** may be disposed above deck **54** to support products proximate deck **54**. Grate **60** (e.g., rack, grill, etc.) is shown spaced apart a distance from deck **54** and configured to allow air pass therethrough, such that air directed toward or along deck **54** will cool products supported on grate **60**. In some embodiments, no grate is present.

Referring to FIG. **2**, cooling system **22** is shown disposed beneath deck **54** at least partially between rear wall **32** and front wall **30** and within cavity **50** according to an exemplary embodiment. Cooling system **22** includes an air flow device shown as fans **62**, a cooling element shown as a cooling coil **64**, a control system, an air inlet **66**, and an air outlet **68**. Cooling system **22** is configured to cool or chill products displayed in refrigerated case **10** and maintain those products a desired temperature. Cooling system **22** generates an air flow **70** that is chilled and distributed throughout refrigerated case **10**. Cooling system **22** circulates a coolant through cooling coil **64**. The control system regulates a flow of coolant in response to the temperature measured within refrigerated case **10**. Fans **62** draw air into cooling system **22** and direct the air through air inlet **66** and through cooling coil **64**. The air passing through cooling coil **64** is chilled or cooled before being discharged from cooling system **22** through air outlet **68** as air flow **70**. Generally, the number, power, and/or size of the air flow device is selected to achieve a desired air flow. For example, in one embodiment, a single fan may be provided, while, in another embodiment, multiple fans may be provided.

Referring further to FIG. **2**, air flow **70** is shown according to an exemplary embodiment including a discharge air flow portion **72**. Discharge air flow portion **72** has at least a first portion **74** and a second portion **76**. Air flow **70** is further shown including an air curtain **78** and a return air flow portion **80**. Air flow **70** is distributed throughout refrigerated case **10** by air distribution system **28**.

Referring to FIG. **3**, intermediate wall **24** is shown substantially vertical and including a top **82**, a bottom **84**, and a lower portion **86** substantially below an upper portion **88** according to an exemplary embodiment. Lower portion **86** of intermediate wall **24** includes a first set of openings **90** and upper portion **88** of intermediate wall includes a second set of openings **92**. Intermediate wall **24** is configured to distribute (e.g., diffuse, disseminate, direct, deliver, disperse, etc.) air from air flow **70** to the product storage area of refrigerated case **10**. Referring back to FIG. **2**, intermediate wall **24** is located at least partially between rear wall **32** and front wall **30** of frame **20** and is spaced a distance from rear wall **32**, defining a cavity **94** therebetween. Cavity **94** (e.g., gap, hollow space, opening, void, etc.) is shown substantially vertical and configured to receive one or more portions of air flow **70**, e.g., first portion **74** and/or second portion **76**. Bottom **84** of intermediate wall **24** is spaced a distance from bottom wall **34** of frame **20**, providing a space through which air flow **70** may enter into cavity **94**. Openings **90** (e.g., holes, slots, apertures, outlets, etc.) of lower portion **86** and openings **92** (e.g., holes, slots, apertures, outlets, etc.) of upper portion **88** provide an exit for air flow **70** from cavity **94**. Sub-portions of first portion **74** and second portion **76** of air flow **70** flow through openings **90**, **92** in intermediate wall **24** and into the product storage space.

Referring further to FIG. **3**, openings **90** in lower portion **86** of intermediate wall **24** are shown in a first pattern including a first row **96** of openings **90** disposed generally above a second row **98** of openings **90**. Openings **92** in upper portion **88** form a second pattern, shown different from the first pattern of lower portion **86**. In one embodiment, the first pattern and the second pattern are the same. In another embodiment, openings **90** and/or openings **92** may be arranged randomly, having substantially no pattern. Generally, the openings in the intermediate wall may be sized, shaped, and/or arranged in any manner to achieve a desired distribution of the air flow and/or air flow velocity. In some embodiments, openings **90** and/or openings **92** may progressively increase in size and/or quantity from bottom **84** to top **82** of intermediate wall **24**. The cavity between the rear wall and the intermediate wall may also be sized and/or shaped to maintain a desired velocity of air flow **70** therethrough and to achieve a desired distribution of air flow **70** through openings **90**, **92** in intermediate wall **24**.

Referring to FIG. **4**, frame **20** is shown further including a plurality of support members shown as frame members **100** according to an exemplary embodiment. Frame members **100** are configured to strengthen and/or stiffen frame **20** and provide support for intermediate wall **24** relative to frame **20**. Frame members **100** are further configured to act as brackets providing for shelves **26** to be coupled or mounted thereto. Frame members **100** are shown substantially vertical and spaced apart between first side **16** and second side **18** of refrigerated case **10** generally along the length of rear wall **32**. Frame members **100** are shown including a plurality slots or other receiving features or structures for coupling a mounting shelves **26** thereto. Frame members **100** are further shown including a plurality of features or structures for coupling lower portion **86** and upper portion **88** of intermediate wall **24** thereto (e.g., holes configured to receive fasteners). In one embodiment, the frame members are integral with the rear wall of the frame. In another embodiment, the frame members are coupled to the rear wall of the frame. In other embodiments, the frame members may be configured in any manner suitable to strengthen and/or stiffen the frame and provide support for the intermediate wall relative to the frame. In still other embodiments, the frame members may be configured in any manner suitable to support the shelves.

Referring further to FIG. **4**, rear wall **32** is shown divided into a plurality of segments **102** defined by frame members **100** according to an exemplary embodiment. Upper portion **88** of intermediate wall **24** is also shown segmented to correspond to segments **102** of rear wall **32**. The segments of upper portion **88** of intermediate wall **24** are coupled substantially between frame members **100**. Lower portion **86** of intermediate wall **24** is shown substantially continuous, extending generally along the length rear wall **32** of frame **20** and in front of frame members **100**. Cavity **94** and shelves **26** may also be segmented or partially segmented to correspond to segments **102** of rear wall **32** (see, e.g., FIG. **1**A illustrating the shelves as segmented). According to other embodiments, both the upper portion and the lower portion of the intermediate wall are continuous, both the upper portion and the lower portion are segmented, or the upper portion is continuous and the lower portion is segmented. According to other embodiments, the rear wall is not segmented.

According to one embodiment, an elongated member shown as L-shaped bracket **104** may be provided. Referring back to FIG. **3**, L-shaped bracket **104** is shown including a first portion **106** that is substantially vertical and a second portion **108** that is substantially horizontal according to an exemplary embodiment. First portion **106** is shown defining lower portion **86** of intermediate wall **24**. Second portion **108** is shown in part defining deck **54**. In other embodiments, the first portion and the second portion of the L-shaped bracket may be two separate components. In other embodiments, the first portion of the L-shaped bracket may be integral with the upper portion of the intermediate wall. In other embodiments, the deck may be a single integral surface (e.g., extending between the intermediate wall and the front wall). In another embodiment, the intermediate wall and the deck may be a single integrated piece. In still another embodiment, the intermediate wall, the deck, and the rear wall of the frame may be integral.

Referring further to FIG. **3**, rear portion **56** of deck **54** is shown disposed substantially adjacent to lower portion **86** of intermediate wall **24** proximate to openings **90** according to an exemplary embodiment. Deck **54** extends at least partially between intermediate wall **24** and front wall **30**. First portion **74** of air flow **70** flows through openings **90** of lower portion **86** of intermediate wall **24** and is directed toward deck **54** to cool products supported thereon or thereabove. Openings **90** are shown above deck **54**. According to other embodiments, the deck may be otherwise disposed relative to the intermediate wall and the openings therein.

Referring back to FIG. **1**A, grate **60** is shown disposed above deck **54** to provide for enhanced cooling of products displayed proximate deck **54** according to an exemplary embodiment. Grate **60** includes a grate rear **110** and a grate front **112**. Grate rear **110** is shown disposed substantially adjacent to lower portion **86** of intermediate wall **24** such that first row **96** of openings **90** is generally thereabove and second row **98** of openings **90** is generally therebelow. As first portion **74** of air flow **70** is discharged through openings **90** in lower portion **86**, sub-portions of first portion **74** of air flow **70** are discharged through first row **96** and through second row **98**. Sub-portions of first portion **74** of air flow **70** discharged through first row **96** of openings **90** are directed toward deck **54** generally above grate **60** (see, e.g., FIG. **7** illustrating air being discharged through the first row of openings in the lower portion of the intermediate wall). Sub-portions of first portion **74** of air flow **70** discharged through second row **98** of openings **90** are directed toward deck **54** generally below grate **60** (see, e.g., FIG. **7** illustrating air being discharged through the second row of the openings in the lower portion of the intermediate wall). Sub-portions of first portion **74** of air flow **70** being discharged through first row **96** of openings **90** are directed primarily at products supported at grate rear **110**, while sub-portions of first portion **74** of air flow **70** discharged through second row **98** of openings are directed primarily at products supported at grate front **112**. Products supported on grate **60** typically cause the velocity of the sub-portions of first portion **74** of air flow **70** exiting above grate **60** to decrease more quickly than the velocity of the sub-portions of first portion **74** of air flow **70** exiting below grate **60**. Accordingly, the sub-portions of first portion **74** of air flow **70** flowing through second row **98** are more likely to reach the products supported at grate front **112** (or to reach the product supported at the grate front with greater velocity) than the sub-portions of first portion **74** of air flow **70** exiting above grate **60**, providing for enhanced cooling of products supported on grate **60**. While grate **60** is shown extending over approximately the entire deck, in other embodiments, the grate may extend over only a portion of the deck. According to still other embodiments, the grate rear may be disposed adjacent to the lower portion of the intermediate wall at locations other than between the first row and the second row of openings. According to still other embodiments, the grate may be disposed adjacent to the intermediate wall at any location.

Referring further to FIG. **1**A, shelves **26** of refrigerated case **10** are shown each having a front portion **114** and a rear portion **116** according to an exemplary embodiment. Each shelf **26** is configured to support products displayed within refrigerated case **10**. Any of a variety of products may be supported on shelves **26**, where the products are cooled and accessible. Rear portion **116** of each shelf **26** is shown disposed adjacent to upper portion **88** of intermediate wall **24** proximate to openings **92**. Products supported on shelves **26** are cooled by sub-portions of second portion **76** of air flow **70**, that are directed through openings **92** of upper portion **88** toward shelves **26** to cool the products supported thereon. Although, shelves **26** are shown cantilevered and supported by a plurality of shelf brackets **118** mounted to frame members **100**, the shelves may be supported in any manner such that the rear portion of each shelf is disposed adjacent or proximate to the intermediate wall. According to other embodiments, the shelves may be otherwise positioned relative to any supporting wall.

Referring back to FIG. **3**, a canopy **120** is shown at least partially defining the top of the product storage space according to an exemplary embodiment. Canopy **120** includes a canopy front **122** and a canopy rear **124**. Canopy **120** is configured to receive air flow **70** exiting the top of cavity **94**. Canopy **120** is further configured to discharge and redirect the remaining portion of air flow **70** toward front wall **30**. Canopy **120** is shown extending from proximate rear wall **32** substantially over cavity **50**. The air is generally directed downward from canopy front **122** toward front wall **30** of frame **20** (e.g., towards the ground/floor) to establish air curtain **78**. Air curtain **78** is configured to help maintain the temperature of the products in refrigerated case **10**. Referring back to FIG. **2**, air curtain **78** is shown flowing generally downwardly over front **12** of refrigerated case **10**. Air curtain **78** is received in an air return **126** as it approaches front wall **30**, providing a boundary or separation between the interior or product space of refrigerated case **10** and the warmer ambient environment external to the case.

Referring back to FIG. **4**, air return **126** is shown extending substantially along front wall **30**, at least partially within cavity **50**. Air return **126** is configured to receive and recirculate at least part of air flow **70** throughout refrigerated case **10**. Air return **126** includes a body **128** and a plurality of openings shown as slots **130**. Slots **130** are generally spaced apart about a top portion **132** of air return **126**. Fans **62** draw air curtain **78** in through slots **130** and through body **128** of air return **126**. Fans **62** then direct return air flow portion **80** from air return **126** through cooling coil **64** of cooling system **22** to be cooled and recirculated.

Referring to FIGS. **2** and **4**, air distribution system **28** includes a plurality of air diverting devices shown as scoops **140** according to a first exemplary embodiment. Scoops **140** are configured to direct first portion **74** of air flow **70** toward deck **54** and permit second portion **76** of air flow **70** to be received in cavity **94** and directed toward shelves **26**. Air distribution system **28** is configured to provide enhanced air flow throughout refrigerated case **10**. Air distribution system **28** is further configured to provide for balanced cooling throughout refrigerated case **10** to help maintain products displayed therein at a substantially uniform temperature (e.g., preventing temperature disparities between products on or proximate the deck and products on the shelves, etc.).

Referring to FIGS. **4** and **5**, each scoop **140** is shown as a formed or molded sheet including a first scoop portion **142** generally above a second scoop portion **144** and a bend **146**. Scoops **140** are configured to receive and direct first portion **74** of air flow **70** discharged from air outlet **68** of cooling system **22** towards deck **54**. Each scoop **140** is shown spaced a distance from intermediate wall **24**, allowing for first portion **74** of air flow **70** to flow substantially in front of scoops **140**. First scoop portions **142**, bends **146**, and second scoop portions **144** at least partially define a flow path for first portion **74** of air flow **70**. Air discharged from air outlet **68** flows along scoops **140** and into cavity **94**. Second scoop portions **144** are shown as substantially planar panels (e.g., flaps, foils, walls, etc.) that extend at least partially beneath bottom **84** of intermediate wall **24** and toward air outlet **68** to receive first portion **74** of air flow **70**. Second scoop portions **144** are shown disposed at an angle relative to first scoop portions **142**. First scoop portions **142** are shown substantially planar and at least partially disposed in cavity **94** substantially parallel to intermediate wall **24**. Bends **146** at least partially define the transition between second scoop portions **144** and first scoop portions **142**, facilitating the change in direction of first portion **74** of air flow **70** as it flows from along second scoop portions **144** to along first scoop portions **142**. Bends **146** are shown substantially uncurved, but, alternatively, may be curved, partially curved, or otherwise shaped in any manner configured to help transition the flow of the first portion of the air flow from along the first scoop portions to along the second scoop portions. The degree of the bend may be varied to achieve a desired flow path, air distribution, and/or air velocity. The scoops are shown generally made of formed sheets of metal, however, according to other embodiments may be molded/formed sheets of plastic, or other materials known in the art. Also, the second scoop portion may be configured extend to various distances below the intermediate wall in order to achieve a desired air flow velocity and air flow distribution.

Referring to FIGS. **6** and **7**, a plurality of plenums **152** disposed at least partially within cavity **94** are shown according to an exemplary embodiment. Plenums **152** are configured to receive first portion **74** of air flow **70** directed into cavity **94** by scoops **140**. Plenums **152** are further configured to confine first portion **74** of air flow **70** substantially between first scoop portion **142** and lower portion **86** of intermediate wall **24** for discharge through only openings **90** in lower portion **86** of intermediate wall **24**. Scoops **130** are shown coupled or disposed relative to intermediate wall **24** to define plenums **152** at least partially between first portions **142** of scoops **130** and intermediate wall **24**. An inlet **154** to each plenum **152** is generally defined between each scoop **140** and intermediate wall **24**. Inlets **154** are configured to permit first portion **74** of air flow **70** to flow therethrough and into plenums **152**. Plenums **152** are not provided with outlets other than openings **90** in lower portion **86** of intermediate wall **24**. A plurality of upper barriers **156** disposed proximate the tops of plenums **152** are configured to further define plenums **152** and to prevent first portion **74** of air flow **70** from exiting plenums **152** and flowing upward toward openings **92** of upper portion **88** of intermediate wall **24**. Additionally, a plurality of side flanges **150** are shown substantially defining the sides of plenum **152**, helping to prevent first portion **74** of air flow **70** from exiting each plenum **152** at its sides (see, e.g., FIG. **5** illustrating side flanges **150**). According to other embodiments, other features of the scoop, the intermediate wall, and/or other components of the refrigerated case may define the plenums.

Referring further to FIG. **7**, upper barrier **156** is shown extending substantially between first scoop portion **142** and intermediate wall **24** according to an exemplary embodiment. Openings **90** of lower portion **86** of intermediate wall **24** are disposed substantially below the location at which upper barrier **156** and intermediate wall **24** converge, and openings **92** of upper portion **88** of intermediate wall **24** are disposed substantially above the location at which upper barrier **156** and the intermediate wall converge. First portion **74** of air flow **70** flows in front of scoop **140** into plenums **152**. Plenums **152** substantially correspond to openings **90** of lower portion **86**. Plenums **152** substantially cover or enclose openings **90**, separating them from the remainder of cavity **94** and at least partially preventing the second portion **76** of air flow **70** from flowing through openings **90** of lower portion **86** of intermediate wall **24**. Openings **90** of lower portion **86** provide an exit through which first portion **74** of air flow **70** may be discharged. Upper barrier **156** helps creates a flow differential that helps direct or force first portion **74** of air flow **70** through openings **90** of lower portion **86**.

Referring to FIG. **7**, according to an exemplary embodiment, upper barriers **156** are substantially formed where upper flanges **158** of scoops **140** are coupled to upper flanges **160** of lower portion **86** of intermediate wall **24**. Upper flanges **158** of scoops **140** are shown extending toward intermediate wall **24** from first scoop portion **142**. Upper flanges **160** of lower portion **86** of intermediate wall **24** are shown extending toward first scoop portions **142** according to an exemplary embodiment. In other embodiments, the upper barrier may be any wall, side, or other obstruction that substantially prevents the first portion of the air flow from exiting the plenums other than through the openings of the lower portion of the intermediate wall. Also, any wall, side, or other obstruction may be provided at the sides of the plenums that substantially prevents the first portion of the air flow from exiting the plenums other than through the openings in the lower portion of the intermediate wall.

Referring back to FIGS. **6** and **7**, scoops **140** are further configured to permit second portion **76** of air flow **70** discharged from air outlet **68** of cooling system **22** to be received in cavity **94** and be directed toward shelves **26** according to an exemplary embodiment. Scoops **140** are shown spaced a distance from rear wall **32** of frame, allowing second portion **76** of air flow **70** to flow substantially rearward of scoops **140**. Second scoop portions **144** are also shown spaced a distanced from bottom wall **34** of frame **20**, providing second portion **76** of air flow **70** an inlet **148** (e.g., entrance, opening, hole, etc.) to cavity **94**. An air directing feature shown as a surface **162** is configured to a least partially direct second portion **76** of air flow **70** into cavity **94**. Surface **162** is shown at least partially curved, defining an at least partially curved air flow path along which second portion **76** of air flow **70** may flow into cavity **94**. Second portion **76** of air flow **70** flows rearward of scoop **140** and generally between rear wall **32** and scoop **140**. Plenums **152** substantially prevent second portion **76** of air flow **70** from accessing and being discharged through openings **90** of lower portion **86**. Second portion **76** of air flow **70** then flows above scoops **140**, where second portion **76** of air flow **70** is provided access to openings **92** in upper portion **88** of intermediate wall **24**. Canopy **120** helps create a pressure differential to discharge second portion **76** of air flow **70** through openings **92**. According to one embodiment the air directing feature may be a substantially uncurved surface forming a 90 degree angle. According to another embodiment, surface **162** may be substantially uncurved and form an angle other than a 90 degree angle. According to other embodiments, the air directing feature may be any feature, element, or device that provides for receipt of second portion **76** of air flow **70** in cavity **94** by providing a flow path thereto (e.g., a duct, an elbow, a tube, a conduit, etc.). Also, the spacing of scoops relative to the rear wall of the frame and the intermediate wall in the cavity may be configured to achieve desired air flow velocity and air flow distribution.

Referring back to FIG. **4**, each scoop **140** is shown aligned proximate rear wall **32** of frame **20** and substantially corresponding to one segment **102** of rear wall **32** according to an exemplary embodiment. Each scoop **140** is shown disposed between frame members **100** defining the segments of rear wall **32** and coupled thereto at a pair of side flanges **150**. In another embodiment, a single scoop extends substantially continuously along the rear wall. In other embodiments, the scoops are not segmented. In still other embodiments, sides, members, walls, sheets, etc. may further help define plenums.

While scoops **140** are shown spaced apart horizontally, in another embodiment, one or more scoops may be spaced apart substantially depthwise and/or substantially vertically in the refrigerated case. For example, the first portions of a plurality of scoops may each be at least partially disposed within the cavity between the intermediate wall and the rear wall such that the first portions are generally aligned and spaced apart from front to back between the rear wall and the intermediate wall. The first portions of the scoops closer to the rear wall may generally extend closer to the top of the intermediate wall than the first portions of the scoops closer to the intermediate wall. The second portions of the scoops extend at least partially beneath the intermediate wall and towards the air outlet of the cooling system to receive a portion of the air flow. The second portions of scoops closer to the rear wall may extend down farther than the second portions of the scoops closer to the intermediate wall. Each scoop may correspond to a different set of openings in the intermediate wall and be configured to discharge a portion of the air flow therethrough. The scoops may get smaller (e.g., shorter, etc.) closer to intermediate wall such that scoops closer to intermediate wall are essentially nested in, though spaced apart from, the scoops closer to the rear wall.

Referring back to FIG. **2**, the operation of air distribution system **28** is shown according to an exemplary embodiment. Air distribution system **28** provides for distribution of first portion **74** of air flow **70** toward product support surface (e.g., deck) disposed adjacent or proximate to lower portion **86** of intermediate wall **24**. First portion **74** of air flow **70** is shown directed by air distribution system **28** toward deck **54** through openings **90** in lower portion **86** of intermediate wall **24**. Air distribution system **28** further provides for distribution of second portion **76** of air flow **70** toward product support surfaces (e.g., shelves) disposed adjacent or proximate to upper portion **88** of intermediate wall **24**. Second portion **76** of air flow **70** is shown directed by air distribution system **28** toward shelves **26** through openings **92** in upper portion **88** of intermediate wall **24**. In this manner, air distribution system **28** provides for enhanced air flow throughout refrigerated case **10**, provides for balanced cooling of products displayed in refrigerated case **10**, and substantially maintains the products displayed in refrigerated case **10** at a uniform temperature.

Discharge air flow portion **72** of air flow **70** is discharged from air outlet **68** of cooling system **22**. Discharge air flow portion **72** is shown flowing generally rearward toward rear wall **32** of frame **20**. Scoops **140** receive and redirect first portion **74** of discharge air flow portion **72** (e.g., intercepts, diverts, etc.). Scoops **140** further permit second portion **76** of discharge air flow portion **72** to flow therebeneath and be received in cavity **94**.

Referring to FIGS. **6** and **7**, first portion **74** of air flow **70** is shown encountering second scoop portions **144** according to an exemplary embodiment. Upon encountering second scoop portions **144**, first portion **74** of air flow **70** flows generally along second scoop portions **144** towards bends **146**. Bends **146** transition first portion **74** of air flow **70**, changing the direction of flow of first portion **74** of air flow **70** from along second scoop portions **144** to along first scoop portions **142**. This flow path directs (e.g., guides, routes, etc.) first portion **74** of air flow **70** in front of scoops **140** and into plenums **152**. First portion **74** of air flow **70** is substantially confined within plenums **152**. Upper barrier **156** acts as a flow restriction, decreasing the velocity of first portion **74** of air flow **70** and creating a pressure differential. The pressure differential created by upper barriers **156** helps direct (e.g., force, guide, discharge, etc.) first portion **74** of air flow **70** through openings **90** in lower portion **86** and toward deck **54**, providing for cooling of products supported on deck **54** or thereabove on grate **60**. After flowing along deck **54** from intermediate wall **24** toward front wall **30**, air exiting openings **90** of lower portion **86** may be drawn into air return **126** by fans **62** proximate front portion of deck **54**. Fans **62** then direct this air, as at least part of return air flow portion **80**, toward cooling system **22** where it is cooled and recirculated.

Referring further to FIGS. **6** and **7**, second portion **76** of air flow **70** is shown flowing beneath scoops **140** and encountering surface **162** according to an exemplary embodiment. Second portion **76** of air flow **70** flows at least partially along surface **162**, which directs second portion **76** of air flow **70** into cavity **94** rearward of scoops **140**, which are disposed at least partially within cavity **94**. Second portion **76** of air flow **70** then flows substantially upward in front of rear wall **32**, but rearward of scoop **140**. Plenums **152** prevent second portion **76** of air flow **70** or sub-portions thereof from being discharged through openings **90** of lower portion **86** of intermediate wall **24**. When second portion **76** of air flow **70** flows above upper barriers **156**, second portion **76** of air flow **70** is provided access to openings **92** of upper portion **88**. Canopy **120**, disposed at least partially above cavity **94**, is configured to help generate a pressure differential to discharge second portion **76** of air flow **70** from openings **92**. Sub-portions of second portion **76** of air flow **70** are discharged or flow through openings **92** in upper portion **88** toward shelves **26**, providing for cooling of products supported on shelves **26**.

Referring back to FIG. **2**, the remaining portion of second portion **76** of air flow **70** that is not distributed through openings **92** in upper portion **88** of intermediate wall **24** flows at least partially out of cavity **94** at the top and into canopy **120**. Canopy **120** directs the remaining air downward toward front wall **30** of frame **20**, forming air curtain **78**. As discussed above, air curtain **78** enhances the performance of refrigerated case **10** by providing a boundary or separation between the refrigerated interior or product space of refrigerated case **10** and the warmer ambient environment external to the case. As air curtain **78** approaches front wall **30** of frame **20** it is drawn into air return **126** by fans **62**. Fans **62** in turn direct this air, as at least part of return air flow portion **80**, through cooling system **22** where it is cooled and recirculated.

Referring to FIGS. **8A-9**, a second embodiment of the refrigerated case shown as refrigerated case **210** is disclosed including an air distribution system **228** having a plurality of air diverting devices shown as scoops **340**.

Referring to FIGS. **8A** and **8B**, refrigerated case **210** further includes a cooling system **222**, an intermediate wall **224**, a plurality of shelves **226**, and a frame **220** having a front wall **230** and a rear wall **232** (similar to cooling system **22**, intermediate wall **24**, shelves **26**, frame **20**, front wall **30**, and rear wall **32** previously described). Frame **220** of refrigerated case **210** further includes a deck **254** and a cavity **294** defined between intermediate wall **224** and rear wall **232** (similar to cavity **94** and deck **54** previously described).

Referring to FIG. **9**, cooling system **222** provides an air flow **270**. Air flow **270** is shown according to a second exemplary embodiment including a discharge air flow portion **272**. Discharge air flow portion **272** includes at least a first portion **274** and a second portion **276**. Air flow **270** is further shown including an air curtain **278** and a return air flow portion **280**. Air flow **270** is distributed throughout refrigerated case **210** by air distribution system **228**.

Referring to FIG. **9**, scoops **340** are configured to receive and direct a first portion **274** of air flow **270** away from cavity **294** and toward deck **254**. Scoops **340** are further configured to permit a second portion **276** of air flow **270** to be received in cavity **294** and directed toward shelves **226**. Scoops **340** are spaced a distance from bottom wall **234**, thereby permitting second portion **276** of air flow **270** to flow therebeneath and into cavity **294**.

Referring to FIGS. **10** and **11**, each scoop **340** includes an air inlet **342**, an air outlet **344**, and a body **346** extending therebetween according to an exemplary embodiment. Both air inlets **342** and air outlets **344** are shown disposed in front of intermediate wall **224**. Bodies **346** of scoops **340** are shown extending through deck **254** to define passages **348** between air inlets **342** shown below deck **254** and air outlets **344** shown above deck **254** (see, e.g., FIG. **12** illustrating passage **348**). Air outlets **344** are further shown including a plurality of slots. Bodies **346** are further shown including a first bend **350** substantially below deck **254** and a second bend **352** substantially above deck **54**. First bends **350** and second bends **352** are at least partially curved and define an at least partially curved flow path through bodies **346**. The angle and radius of each bend **350**, **352** affects the directional change of first portion **274** of air flow **270** through and/or along scoops **140**. The size and/or shape of air inlets **342** and air outlets **344** may be adjusted to achieve a desired air flow distribution and/or air flow velocity. Also, the angle and radius of each bend **350**, **352** can be adjusted to achieve a desired air flow velocity and direction. According to one embodiment, first bends **350** and second bends **352** have substantially the same angle and radius. According to other embodiments, first bends **350** and second bends **352** have different angles and/or different radii. According to other embodiments, bends **350**, **352** may be uncurved bends. According to other embodiments, the air outlets may have slots or other openings sized, shaped, and/or arranged in any manner to achieve a desired air flow and/or air flow velocity.

Referring to FIGS. **11** and **12**, a first portion **354** of each body **346** is disposed at least partially below deck **254** and a second portion **356** of each body **346** is disposed at least partially above deck **54**. First portions **354** of bodies **346** are shown substantially vertical, extending below deck **254** and generally in front of or proximate to an air outlet **268** of cooling system **222** to receive first portion **274** of air flow **270** therein. Second portions **356** of bodies **346** are shown substantially horizontal, extending along substantially horizontal deck **254** toward front wall **230** for a distance. A desired air flow distribution and/or air flow velocity may be achieved by adjusted by the distance that first portion **354** extends below deck. All else equal, the farther the first portions **356** of bodies **346** of scoops **340** extend below the deck **254**, the greater the volume of the first portion of the air flow that is received in scoops **340**. According to other embodiments, the first portions and the second portions may be disposed at any of a number of angles relative to each other and/or the deck.

Referring to FIGS. **12** and **13**, the operation of air distribution system **228** is shown according to an exemplary embodiment. Air distribution system **228** provides for distribution of first portion **274** of air flow **270** toward deck **254**. Deck **254** is shown disposed adjacent or proximate to a bottom **284** of intermediate wall **224**. First portion **274** of air flow **270** is shown directed by away from cavity **294** toward deck **254** by scoops **340**. Air distribution system **228** further provides for distribution of second portion **276** of air flow **270** toward deck **254** and shelves **226**. Shelves **226** are shown disposed adjacent or proximate to intermediate wall **224** above deck **254**. In this manner, air distribution system **228** provides for enhanced air flow throughout refrigerated case **210**, provides for balanced cooling of products displayed in refrigerated case **210**, and substantially maintains the products displayed within refrigerated case **210** at a uniform temperature.

Referring to FIG. **12**, discharge air flow portion **272** of air flow **270** is discharged from air outlet **268** of cooling system **222**. Discharge air flow portion **272** flows generally rearward toward rear wall **232** of frame **220**. Scoops **340** receive and direct (e.g., intercept, divert, etc.) first portion **274** of air flow **270** away from cavity **294** and towards deck **254**. Scoops **340** further permit second portion **276** of air flow **270** to flow therebeneath and into cavity **94**.

Referring to FIG. **13**, first portion **274** of air flow **270** is shown encountering air inlets **342** of scoops **340** as discharge air flow portion **272** flows substantially rearward according to an exemplary embodiment. Air inlets **342** receive first portion **274** of air flow **270**. First portion **274** of air flow **270** flows through passages **348** defined by bodies **346** of scoops **340**. First bends **350** of scoop bodies **346** direct first portion **274** of air flow **270** generally vertically upward and above deck **254**. Above deck **254**, first portion **274** of air flow **270** encounters second bends **352**. Second bends **352** of scoop bodies **346** direct first portion **274** of air flow **270** generally horizontally. First portion **274** of air flow **270** then flows substantially horizontally through passages **348** toward front wall **230** of frame **220** until it is discharged from air outlets **344** of scoops **340**. Upon being discharged from air outlets **344**, first portion **274** of air flow **270** flows along deck **254** towards front wall **230** until being drawn into an air return **326** and directed, as at least part of return air flow portion **280**, toward cooling system **22** where it is cooled and recirculated.

Referring further to FIG. **13**, second portion **276** of air flow **270** is shown flowing at least partially beneath scoops **340** and intermediate wall **224** where it encounters a surface **362** according to an exemplary embodiment. Surface **362** is configured to at least partially direct second portion **276** of air flow **270** into cavity **294**. Second portion **276** of air flow **270** flows generally along surface **362** into cavity **294**. Second portion **276** of air flow **270** is shown flowing through cavity **294** until being discharged from a plurality of openings **364** in intermediate wall **224**. A canopy **320**, shown disposed at least partially above cavity **294**, is configured to help generate a pressure differential that helps discharge second portion **276** from openings **364** in intermediate wall **224**. Second portion **276** of air flow **270** flows through openings **364** toward shelves **226**, providing for cooling of products supported on shelves **226**.

Referring back to FIG. **12**, the remaining portion of second portion **276** of air flow **270** that is not distributed through openings **364** of intermediate wall **224** flows out of the top of cavity **294** and into canopy **320**. Canopy **320** helps direct the remaining air generally downward toward front wall **230** of frame **220**, forming air curtain **278**. As discussed above, air curtain **278** enhances the performance of refrigerated case **210** by providing a boundary or separation between the refrigerated interior or product space of refrigerated case **10** and the warmer ambient environment external to the case. As air curtain **278** approaches front wall **230** of frame **220**, it is drawn into air return **326** and directed, as at least part of return air flow portion **280**, toward cooling system **222** where it is cooled and recirculated.

Referring to FIGS. **14** and **15**, a plurality of shelves **426** are provided in refrigerated case **410** according to a third exemplary embodiment.

Referring to FIG. **14**, refrigerated case **410** further includes a cooling system **422** configured to discharge an air flow **470**, an intermediate wall **424**, a plurality of shelves **426**, an air distribution system **428**, and a frame **420** (similar to cooling system **22**, air flow **70**, intermediate wall **24**, shelves **26**, air distribution system **28**, and frame **20** previously described). Frame **420** of refrigerated case **410** further includes a cavity **494** defined between intermediate wall **224** and rear wall **232** (similar to cavity **94** previously described).

Referring to FIG. **15**, cooling system **422** provides an air flow **470**. Air flow **470** is shown according to a second exemplary embodiment including a discharge air flow portion **472**. Discharge air flow portion **472** has at least one portion **476**. Portion **476** of air flow has a plurality of sub-portions, including a first sub-portion **482** and a second sub-portion **484**.

Referring further to FIGS. **14** and **15**, each shelf **426** includes a front portion **429** and a rear portion **430**, wherein rear portion **430** of each shelf **426** is generally open and disposed adjacent or proximate to intermediate wall **424**. Each shelf **426** further includes a shelf base **564**, a shelf cover **566** having a plurality of openings **568**, and a space **570** defined therebetween. Shelf covers **566** are shown disposed at an angle relative to shelf bases **564** and coupled thereto. Each shelf base **564** includes a front edge **572** and a rear edge **574**. Each shelf cover **566** includes a front edge **576** and a rear edge **578**. Front edge **576** of each shelf cover **566** is coupled to front edge **572** of the corresponding shelf base **564**. Rear edge **578** of each shelf cover **566** is spaced a distance from rear edge **574** of the corresponding shelf base **564**. Spaces **570** are shown as a wedge-shaped spaces defined by the shelf cover and shelf base pairings. Spaces **570** generally extend from the rear edges toward the front edges of each shelf cover and shelf base pairing. Shelf covers **566** are configured to be adjustable relative to shelf bases **564**, providing for the cross-section of spaces **570** defined therebetween to be adjusted. In the embodiment shown, the angle of shelf covers **566** relative to shelf bases **564** may be adjusted, changing the angle and/or the cross-section of spaces **570** therebetween. The shelf covers may be adjusted to achieve a desired air flow and/or air flow velocity.

Referring to FIG. **15**, openings **568** in shelf covers **566** are configured to distribute one or more sub-portions of portion **476** of air flow **470** received in spaces **570** through a plurality of openings **580** in intermediate wall **424**. Openings **568** are shown as circular holes disposed at a front portion **582** of each shelf cover **566** of shelves **426** and arranged in a pattern. The openings in the shelf covers are sized, shaped, and/or arranged in a pattern intended to achieve a desired distribution of air flow and/or maintain a desired air flow velocity. Openings **568** may vary in size, shape, pattern, and/or arrangement (e.g., the shelf cover openings may include large circular holes and/or a series of openings forming a honeycomb patterns, etc.). In some embodiments, openings **568** in shelf covers **566** may get progressively larger the higher the shelf is disposed relative to intermediate wall **424** (e.g., the closer to the top of the intermediate wall) in order to achieve a desired air flow and/or air flow velocity.

According to other embodiments, openings **568** in shelf covers **566** may form a first pattern on one shelf and a second pattern on a shelf thereabove. The first pattern and the second pattern may be the same. Alternatively, the first pattern and the second pattern may differ. In another embodiment, the openings in the shelf cover of each shelf may be the same size, but may become progressively more numerous the higher the shelf is disposed relative to the intermediate wall. In some embodiments, the openings in the shelf covers of a plurality of shelves increase in both size and number the higher each shelf is disposed relative to the intermediate wall.

Referring further to FIG. **15**, each shelf **426** is disposed relative to intermediate wall **424** such that at least some openings **580** are located above each shelf cover **566** and some openings **580** are located between each shelf cover **566** and shelf base **564** pairing. Openings **580** above each shelf cover **566** are intended to distribute sub-portions (e.g., first sub-portion **482**) of portion **476** of air flow **470** above and generally along each shelf cover **566** (e.g., in a first flow path). These sub-portions are primarily directed at rear portions **430** of shelves **426**. Openings **580** between each shelf cover **566** and corresponding shelf base **564** are intended to distribute sub-portions (e.g., second sub-portion **484**) of portion **476** of air flow **470** into spaces **570** therebetween. The sub-portions of portion **476** of air flow **470** received in spaces **570** are distributed through openings **568** (e.g., in a second flow path). As openings **568** are disposed toward front portions **582** of shelf covers **566**, the sub-portions of portion **476** of air flow **470** received in spaces **570** are primarily directed at front portions **429** of shelves **426**. Spaces **570** in shelf covers **566** may be configured to achieve a desired velocity of the sub-portions of portion **476** of air flow **470** flowing through openings **568** (e.g., the spaces may have a cross section that generally decreases moving from the rear portion toward the front portion of each shelf, such as the wedge shaped space discussed above, etc.). In other embodiments, the shelf cover and the shelf base may be integrally formed in any manner wherein a space is defined therebetween, or the shelves may not include shelf covers.

According to any preferred embodiment, a straight case is provided with a frame, a cooling system, an intermediate wall, a plurality of shelves, and an air distribution system. The frame includes a front wall and a rear wall. The cooling system includes an air flow device providing an air flow discharged through an air outlet. The intermediate wall is spaced a distance from the rear wall to define a cavity. The cavity may extend substantially vertically. The intermediate wall includes a plurality of openings through which air may be discharged. The plurality of openings may include a first set of openings disposed substantially below a second set of openings. Each shelf may include a front portion and a rear portion. The rear portions of the shelves may be disposed proximate the second set of openings such that the air discharged from these openings is directed toward the shelves. A deck extending at least partially between the intermediate wall and the front wall of the frame and having a front portion and a rear portion is also provided. The rear portion of the deck is disposed proximate the first set of openings such that air discharged from these openings is directed toward the deck. The air distribution system includes one or more air diverting devices each having first portion substantially above a second portion and a bend defining the transition between the first portion and the second portion. The first portion of the air diverting device is disposed at least partially within the cavity. The second portion of the air diverting device is disposed at an angle relative to the first portion of the air diverting device and extends generally toward the air outlet. The second portion of the air diverting device extends at least partially beneath the intermediate wall. The second portion of the air diverting device may be curved, substantially planar, or partially curved. The air diverting device is configured to direct a first portion of the air flow into the cavity and through the first set of openings and permit a second portion of the air flow to flow into the cavity and be directed through the second set of openings. At least one plenum may be at least partially defined by coupling the air diverting device and the intermediate wall, the plenum being configured to air directed therein by the air diverting device. An upper barrier and/or side flanges may be provided to help prevent the first portion of the air flow from flowing out of the plenum and out of the second set of openings. The plenum may further be configured to prevent the second portion of the air flow, directed generally rearward of the air diverting device, from accessing and exiting through the first set of openings.

According to another preferred embodiment, a straight case is provided with a frame, a cooling system, an intermediate wall, a plurality of shelves, and an air distribution system. The frame includes a front wall and a rear wall. The cooling system includes an air flow device providing an air flow discharged through an cooling system air outlet. The intermediate wall is spaced a distance from the rear wall to define a cavity. The cavity may extend substantially vertically. The intermediate wall includes a plurality of openings through which air may be discharged. Each shelf includes a front portion and a rear portion. The rear portion of each shelf may be disposed proximate the openings in the intermediate wall such that the air discharged from these openings is directed toward the shelves. A deck extending at least partially between the intermediate wall and the front wall of the frame and having a front portion and a rear portion is also be provided. The rear portion of the deck is disposed below the shelves and proximate openings in the intermediate wall. The air distribution system includes at least one air diverting device having a body extending through the deck, at least one air outlet above the deck, and at least one air inlet below the deck. The air inlet and the air outlet may be disposed in front of the intermediate wall. The body of the air diverting device at least partially forms a passage between the air inlet and the air outlet. The body of the air diverting device includes a first portion at least partially above the deck and a second portion below the deck. The body further includes a first bend below the deck and a second bend above the deck. The first and second bends are at least partially curved, defining an at least partially curved flow path therebetween. The air diverting device is configured to direct a first portion of the air flow away from the cavity and toward the deck and permit a second portion of the air flow to flow into the cavity and be directed toward the shelves. The second portion of the air flow is discharged from the cavity through the openings in the intermediate wall. The first portion is discharged through the air outlet of the air diverting device.

According to another preferred embodiment, a straight case is provided with a frame, a cooling system, an intermediate wall, a plurality of shelves, and an air distribution system. The frame includes a front wall and a rear wall. The cooling system includes an air flow device providing an air flow discharged through an cooling system air outlet. The intermediate wall is spaced a distance from the rear wall to define a cavity. The cavity extends substantially vertically. The intermediate wall includes a plurality of openings through which air is discharged. Each shelf includes a front portion and a rear portion. Each shelf further includes a shelf cover disposed generally above a shelf base and a space defined therebetween. The shelf cover is at an angle relative to the shelf base and the space therebetween is a wedge-shaped space. The shelf cover is also adjustable relative to the shelf base to adjust the cross-section of the space therebetween. The rear portion of each shelf is generally open between the shelf cover and the shelf base. Each shelf cover further includes a plurality of openings configured to discharge sub-portions of a portion of the air flow therethrough. The openings in the shelf cover are disposed proximate a front portion of the shelf cover. The air distributions system directs air in a first flow path above the shelf cover toward the rear portion of the shelf. The air distribution system further directs air in a second flow path through the space, out the openings in the shelf cover, and toward the front portion of the shelf. The shelves may be used in combination with one or more air diverting devices having any of a number of configurations.

As utilized herein, the terms "approximately," "about," "substantially," and similar terms are intended to have a broad meaning in harmony with the common and accepted usage by those of ordinary skill in the art to which the subject matter of this disclosure pertains. It should be understood by those of skill in the art who review this disclosure that these terms are intended to allow a description of certain features described and claimed without restricting the scope of these features to the precise numerical ranges provided. Accordingly, these terms should be interpreted as indicating that insubstantial or inconsequential modifications or alterations of the subject matter described and claimed are considered to be within the scope of the invention as recited in the appended claims.

It should be noted that the term "exemplary" as used herein to describe various embodiments is intended to indicate that such embodiments are possible examples, representations, and/or illustrations of possible embodiments (and such term is not intended to connote that such embodiments are necessarily extraordinary or superlative examples).

The terms "coupled," "connected," and the like as used herein mean the joining of two members directly or indirectly to one another. Such joining may be stationary (e.g., permanent) or moveable (e.g., removable or releasable). Such joining may be achieved with the two members, or the two members and any additional intermediate members, being integrally formed as a single unitary body with one another, or with the two members, or the two members and any additional intermediate members, being attached to one another.

It should be noted that the orientation of various elements may differ according to other exemplary embodiments, and that such variations are intended to be encompassed by the present disclosure (e.g., the scoops relative to the tower, the air flow relative to the deck, etc.).

It is also important to note that the construction and arrangement of the refrigerated case as shown in the various exemplary embodiments is illustrative only. Although only a few embodiments of the present inventions have been described in detail in this disclosure, those skilled in the art who review this disclosure will readily appreciate that many modifications are possible (e.g., variations in sizes, dimensions, structures, shapes and proportions of the various elements, values of parameters, mounting arrangements, use of materials, colors, orientations, etc.) without materially departing from the novel teachings and advantages of the subject matter disclosed herein. For example, elements shown as integrally formed may be constructed of multiple parts or elements, the position of elements may be reversed or otherwise varied, and the nature or number of discrete elements or positions may be altered or varied. Accordingly, all such modifications are intended to be included within the scope of the present invention as defined in the appended claims. The order or sequence of any process or method steps may be varied or re-sequenced according to alternative embodiments. Other substitutions, modifications, changes and omissions may be made in the design, operating conditions and arrangement of the various exemplary embodiments without departing from the scope of the present inventions.

What is claimed is:

1. A temperature-controlled case, comprising:

a rear wall and a front wall;

an air flow device and an air outlet disposed at least partially between the rear wall and the front wall, the air flow device configured to provide an air flow discharged through the air outlet;

an intermediate wall spaced apart from the rear wall to define a cavity, the intermediate wall including a first plurality of openings having a first pattern defined by a first size, shape and spacing and a second plurality of openings having a second pattern defined by a second size, shape and spacing disposed substantially above the first plurality of openings, the first pattern being different than the second pattern;

at least one air diverting device comprising a first portion substantially parallel to the intermediate wall, an upper barrier connecting an upper edge of the first portion to the intermediate wall, and a second portion extending beneath the intermediate wall toward the air outlet;

the air diverting device configured to receive and direct a first portion of the air flow through the first plurality of openings and away from the second plurality of openings and to permit a second portion of the air flow to be directed through the second plurality of openings and away from the first plurality of openings.

2. The temperature-controlled case of claim **1**, wherein the air diverting device is a single air diverting device that extends substantially continuously along the rear wall.

3. The temperature-controlled case of claim **1**, wherein the air diverting device comprises a plurality of air diverting devices aligned proximate the rear wall.

4. The temperature-controlled case of claim **3**, wherein the rear wall includes a plurality of segments, each of the air diverting devices substantially corresponding to one of the plurality of segments of the rear wall.

5. The temperature-controlled case of claim **1**, wherein the air diverting device comprises a formed sheet having a first portion generally above a second portion and a bend defining a transition therebetween.

6. The temperature-controlled case of claim **5**, the first portion of the air diverting device being at least partially disposed within the cavity.

7. The temperature-controlled case of claim **6**, wherein the second portion of the air diverting device is disposed at an angle relative to the first portion.

8. The temperature-controlled case of claim **6**, wherein the second portion of the air diverting device is a substantially planar panel.

9. The temperature-controlled case of claim **6**, wherein the air diverting device is coupled to the intermediate wall to define a plenum at least partially between the first portion of the air diverting device and the intermediate wall to substantially separate and confine air from the first portion of the air flow between the air diverting device and the intermediate wall for discharge only through the first plurality of openings, and to prevent the second portion of the air flow discharging through the first plurality of openings.

10. The temperature-controlled case of claim **9**, wherein the upper barrier further defines the plenum, the upper barrier extending substantially between the first portion of the air diverting device and the intermediate wall to prevent the first portion of the air flow from flowing to the second plurality of openings.

11. The temperature-controlled case of claim **10**, wherein the first plurality of openings are disposed substantially below the location at which the upper barrier and the intermediate wall converge, and the second plurality of openings are disposed substantially above the location at which the upper barrier and the intermediate wall converge.

12. A temperature-controlled case, comprising:

a rear wall, a front wall, and a deck having a front portion and a rear portion;

an air flow device configured to provide an air flow;

an intermediate wall spaced apart from the rear wall to define a cavity;

at least one shelf including a front portion and a rear portion, the rear portion of the shelf disposed adjacent to the intermediate wall; and

at least one air diverting device configured to receive and direct a first portion of the air flow through the cavity and through a first pattern of openings defined by a first size, shape and spacing toward the deck and to permit a second portion of the air flow to be received in the cavity and be directed through a second pattern of openings defined by a second size, shape and spacing toward the shelf;

wherein at least one of the first size, shape and spacing of the first pattern of openings is different from at least one of the second size, shape and spacing of the second pattern or openings;

wherein the first pattern of openings includes an upper row of openings configured to direct a first sub-portion of the first portion of the air flow toward the rear portion of the deck and a lower row of openings configured to direct a second sub-portion of the first portion of the air flow toward the front portion of the deck.

13. The temperature-controlled case of claim **12**, wherein the intermediate wall comprises a first set of openings disposed substantially below a second set of openings, and wherein the rear portion of the deck is disposed adjacent to the intermediate wall proximate the first set of openings, and the rear portion of the shelf is disposed adjacent to the intermediate wall proximate the second set of openings.

14. The temperature-controlled case of claim **13**, wherein the air diverting device directs the first portion of the air flow through the first set of openings towards the deck and permits the second portion of the air flow to flow through the second set of openings toward the at least one shelf.

15. The temperature-controlled case of claim **12**, wherein the first portion of the air flow flows substantially in front of the air diverting device and the second portion of the air flow flows substantially rearward of the air diverting device.

16. The temperature-controlled case of claim **12**, wherein the air diverting device at least partially defines a plenum at least partially enclosing the first set of openings and thereby at least partially preventing the second portion of the air flow from flowing through the first set of openings.

17. The temperature-controlled case of claim **16**, wherein a first portion of the air diverting device is at least partially disposed within the cavity substantially parallel to intermediate wall.

18. A temperature-controlled case, comprising:

a front wall, a rear wall, and a deck, the deck extending at least partially between the front wall and the rear wall;

an air flow device disposed beneath the deck and configured to provide an air flow;

an intermediate wall spaced apart from the rear wall to define a cavity, the intermediate wall including a first plurality of openings defining a first pattern having a first size, shape and spacing, and a second plurality of openings having a second size, shape and spacing, the first pattern being different from the second pattern;

at least one shelf including a front portion and a rear portion, the rear portion of the shelf disposed adjacent to the intermediate wall; and

at least one air diverting device configured to receive and direct a first portion of the air flow away from the second plurality of openings and through the first plurality of openings toward the deck and configured to permit a second portion of the air flow to be directed away from the first plurality of openings and through the second plurality of openings toward the shelf;

wherein the first pattern of openings includes an upper row of openings configured to direct a first sub-portion of the first portion of the air flow toward a rear portion of the deck and a lower row of openings configured to direct a second sub-portion of the first portion of the air flow toward a front portion of the deck.

19. The temperature-controlled case of claim **18**, wherein the first portion of the air flow is directed only through the first plurality of openings having the first pattern and the second portion of the air flow is directed only through the second plurality of openings in the intermediate wall having the different second pattern.

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